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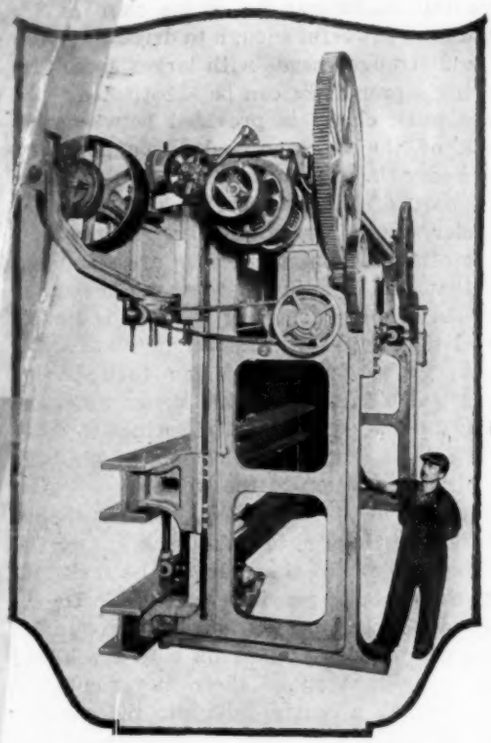


The Hill Multiple-Spindle Drilling Machine

EDITORIAL CORRESPONDENCE

The machine described and illustrated herewith has a spindle drive of a design which permits of close spacing of the drilling heads, and yet the mechanism is very simple. The design is such that machines of various sizes may be easily built on order to accommodate the different classes of work they can handle.

THE multiple-spindle drilling machine that is the subject of this article is made by the Hilldrill Co., 2141 North 19th St., Philadelphia, Penn. Several of this type of machine are also being built by the Badenhausen Co., 1425 Chestnut St., Philadelphia. It is intended for multiple drilling of structural-steel members, but it is applicable to practically all multiple-drilling operations on ship and boiler plates, both in the flat and after rolling and forming to shape, and to other work requiring the drilling, cutting or boring of a large number of holes. The construction of the machine is so simple that there is little chance of trouble even when operated by unskilled help. Some of the main features of the machine are that it feeds down the drills automatically; it clamps the work in place, exerting over 20 tons pressure, and thus will straighten out any ordinary sweep or buckles in plates; it lubricates the drills individually and stops this lubricating when the machine is not in operation; it stops automatically when the drilling is done, releases the clamp automatically and is ready for the next cycle of operation, and it is smooth in its running and uses a comparatively small amount of power. The machine shown in Fig. 2 carries 50 drill heads for $1\frac{1}{16}$-in. drills and feeds 0.005 in. per revolution of the spindles. Thirty-two cutter heads for $3\frac{1}{4}$-in. tube holes may be used in the place of the 50 drills. Each drill unit is moved along the rail to any place desired by raising a lever and the units clamped in place by means of the same lever, making spacing as close as $2\frac{3}{4}$ in. in 3 to 5 sec. By raising the same levers a few inches higher than for releasing the clamp the drill unit may be entirely released and taken off to change for larger units. These machines can be built to a length of 40 ft. or more, a size which makes them available for drilling over 100 rivet holes at one operation and at one setting of the work. The one shown weighs about 26 tons and is of about 20 ft. span. At the sides are two cast-iron housings *A*, the bases of which are secured to a concrete foundation. The tops of these housings are tied together by two members *B* made of heavy flanged pipe which are amply stiff and comparatively light in weight. In the front, at the bottom, the housings are held together by a heavy I-beam *C*. On each housing is a slide *D* which carries the table *E* of the machine. In this instance the table is an I-beam, but of course various forms are used to suit the work in hand. The table is raised and lowered by means of four screws *F* 3 in. in diameter and operated by a power worm drive. The cross-rail which carries the drilling heads, or units, is a heavy I-beam section. Between the flanges it is planed from end to end on both sides to form a

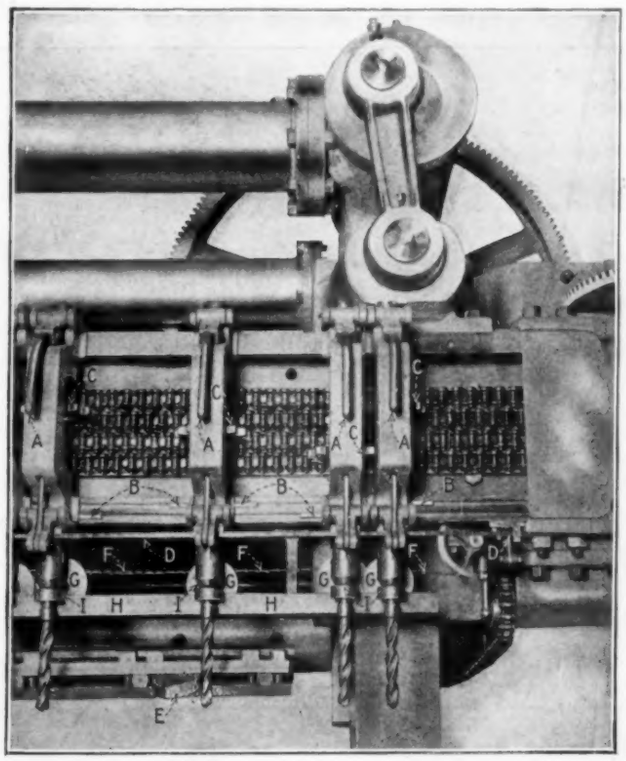


FIG. 1. SOME DETAILS OF THE MECHANISM

runway for the roller chains *G* that drive the drill spindles. These flanges are also planed on their faces, tops and bottoms to form seats for the drilling heads.

The chains that rotate the spindles run over sprockets at each end of the cross-rail. The sprockets at the right-hand end of the rail are keyed to the same shaft as the bevel gear *H*, which is driven by means of a bevel pinion from the pulley *I*. The sprockets at the left-hand end of the rail are idlers. At the lower end of the shaft carrying the bevel gear *H* is a worm *J*, which operates the feed mechanism.

On top at the back of the machine two large spur gears *K* are mounted in the housings. These gears are timed to turn in unison. On the front ends of the shafts on which they are mounted are two disk cranks *L* with rods *M* connecting with the cross-rail. This mechanism is so arranged as to feed the cross-rail and drills down slowly and returns almost instantly to its highest position, when the clutch is tripped and the machine stops. It is now ready for the next operations.

A close-up view of one end of the top of the machine and cross-rail is shown in Fig 1. This shows the clamping levers *A*, by which the drill units may be clamped, loosened to slide along the rail or removed entirely. The units are kept from cocking over as they are slid along the rail by means of keys like *B*, which slide in grooves planed in the cross-rail. There are two grooves and the keys of alternate heads are staggered in order not to interfere with the close setting of the heads. This is also true of the sprockets, as will be seen from those shown at *C*.

When the heads are attached to the rail the clamping mechanism is only partly tightened. A lever placed in the drift hole in the spindle is then used to rack the head to its proper position, the sprocket and chain acting as pinion and rack for this. A steel tape *D* running from end to end of the machine facilitates setting the heads to correct spacing. The setting to position is simply and easily done and the entire set of heads can be placed in about eight minutes. In the machine shown the heads may be set as close as $2\frac{3}{4}$ in. and are more than powerful enough to drive a $1\frac{1}{16}$-in. drill. Larger and stronger heads with larger sprockets capable of driving larger drills can be substituted.

An ingenious work clamp is provided between the front and back of the machine and throughout its entire length a heavy clamping member is pivoted. The upper forward part of this member is connected by links to the under side of the cross-rail. At intervals along the front of the clamping member are clamping fingers like *E* that can be adjusted to clamp the work between the drills. As the clamping member is linked to the cross-rail the weight of the rail in its descent and the thrust of the feed mechanism furnish the clamping power which in the machine shown amounts to approximately 20 tons. Heavy helical springs cushion the clamps and compensate for the change of position of the cross-rail with relation to the work.

Lubrication of the drills is by gravity. A simple mechanism causes the chain *F* to work back and forth. This chain engages teeth to the rear of the disks *G*. The disks are at the back provided with a series of pockets which reach down into the lubricant trough *H*. In their bottom position the pockets fill with the lubricant, and then near the top of their movement the lubricant flows through a central hole into the tubular stem on which the disks are mounted. The front end of this tubular stem is so located that the lubricant passes into a gutter *I* turned around the spindle end and from there passes through holes to the drill. As the lubricating device is integral with each head no adjustment of the lubricating mechanism is necessary when placing or altering the position of the heads on the rail, thus the flow of lubricant ceases when the machine stops.

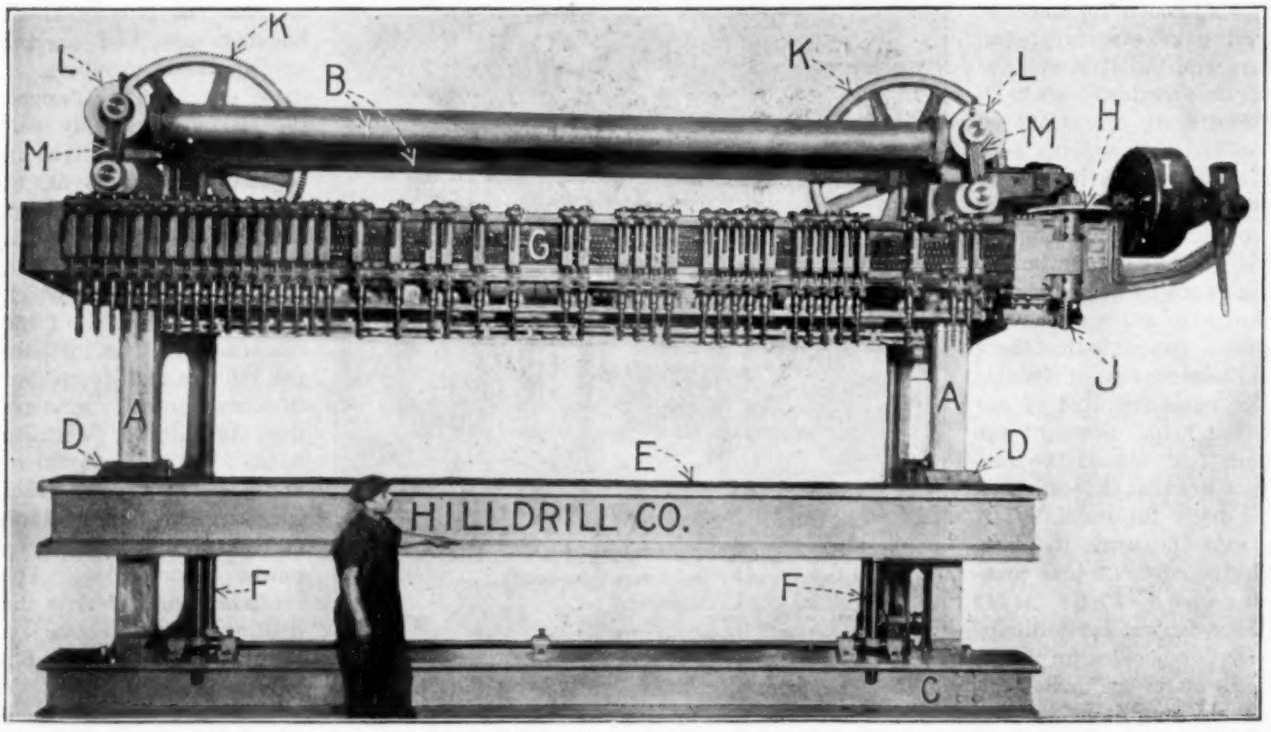
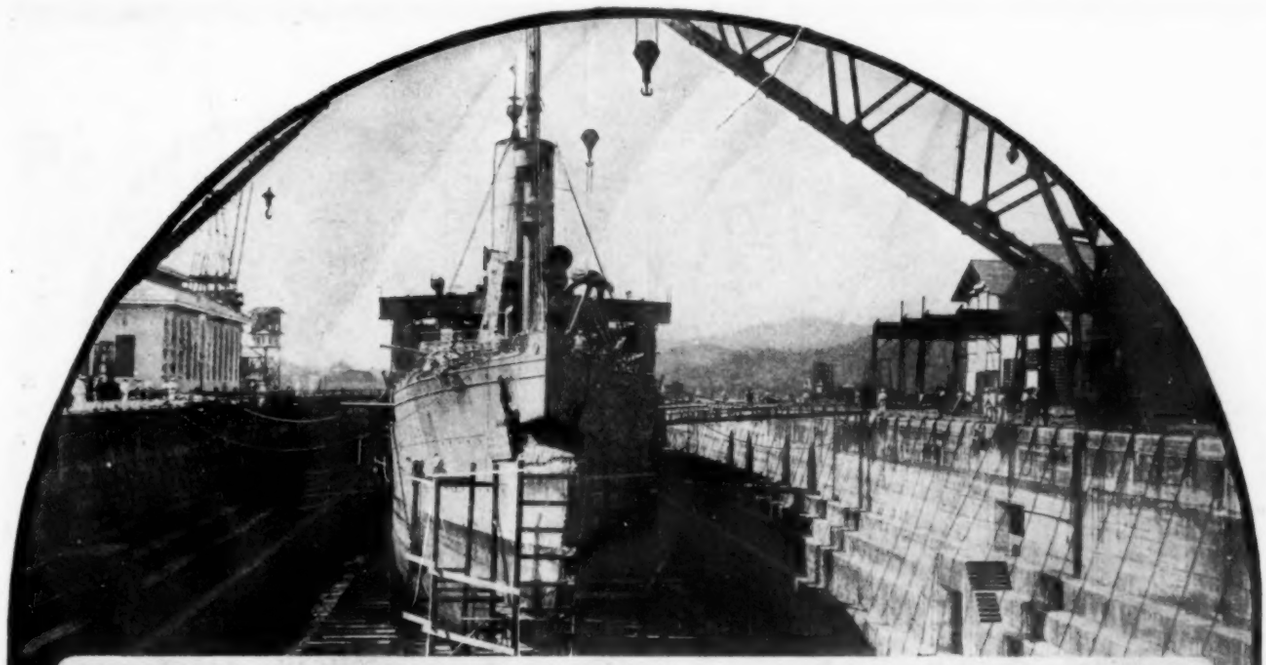


FIG. 2. MULTIPLE-SPINDLE DRILLING MACHINE MADE BY THE HILLDRILL CO.



WAR TIME WORK *at* BALBOA SHOPS.
Panama Canal

By R. D. GATEWOOD
Naval Constructor, Mechanical Superintendent of the Canal Zone

Nothing could show better than the illustrations presented with this article the great variety of work being done at the Balboa shops of the Panama Canal. And nothing shows the versatility and practical experience of the men on the job to better advantage. Not to be daunted by a lack of launching facilities they lift boats 120 ft. long and weighing over 200 tons and swing them into the water. We know of nothing in this line that gives a greater feeling of satisfaction than such a record, for it is one which reflects a great deal of credit on the whole personnel of these shops.

IT MAY be doubted if ever in the history of the expenditure of Government funds a wise policy of foresight and preparedness has ever received a more convincing demonstration than that furnished during the war by the Balboa shops of the Panama Canal. In war work alone these shops have several times paid for themselves since our entry into the great struggle, and each day adds to their usefulness as a great national asset.

It would not yet be wise to enter into too many of the details of war work, but it may be mentioned that in addition to the complete overhauling of four good-sized German cargo steamers interned in Colon harbor the shops have performed work, in many cases of an extensive nature, on over one hundred naval vessels and more than five hundred merchant vessels. Nearly all the latter were loaded with valuable and urgently needed war-time cargoes.

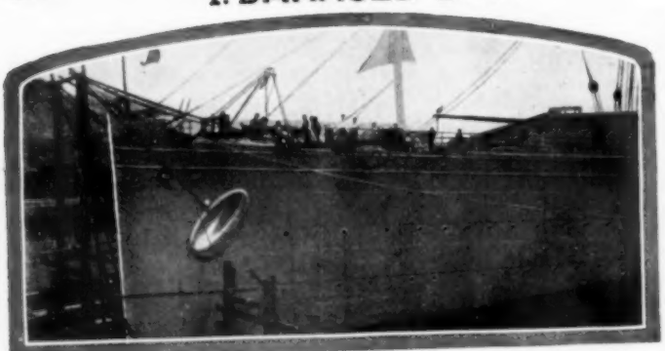
It is strange how little even the better informed among the shipping world know of the facilities and possibilities of this splendid repair plant. Agents, owners, masters and insurance men inspecting it for the first time are universally astonished at its capacity and its ability to handle almost any conceivable job of marine repair work.

Probably in no other plant in the world is the variety of work handled greater than at these shops. There are no other large shops for 1500 miles, and as a consequence this Government plant must do not only the maintenance and construction work of the Panama Canal, including the Panama Railroad, but all the work for the Navy, the Army, merchant shipping traversing the canal and a large amount of work for private establishments for mines, mills and other development projects in Central and South America.

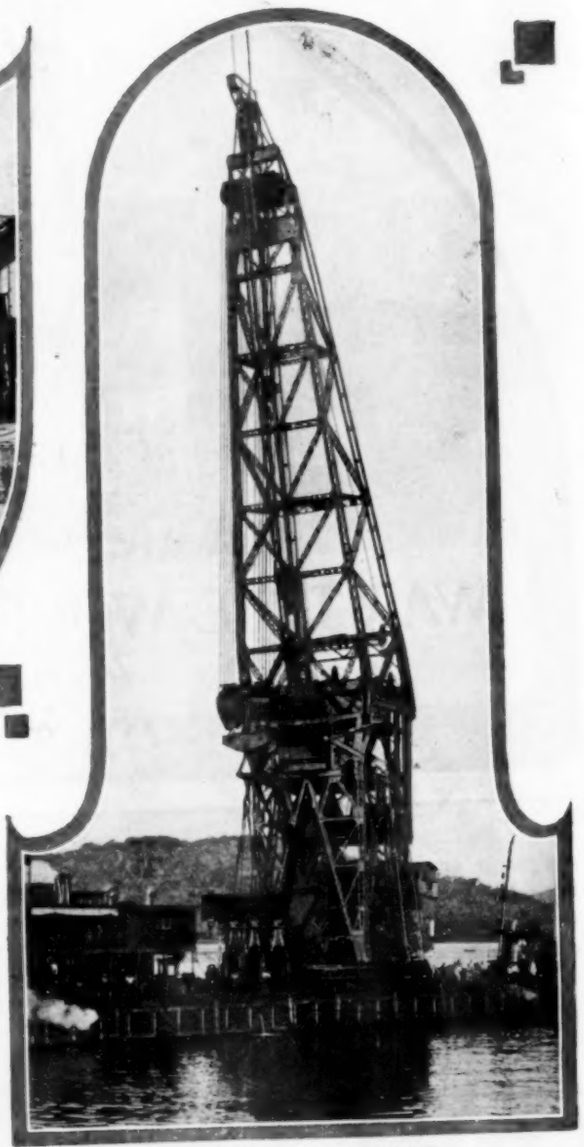
A fair idea of this variety of work may best be obtained by glancing at the illustrations. The headpiece and Figs. 1 and 2 show a large repair job being begun on a vessel in the great 1000-ft. drydock. The stern of this vessel had also been severely damaged, but the damage is not shown.

In general the work included a new stem, a new hawse

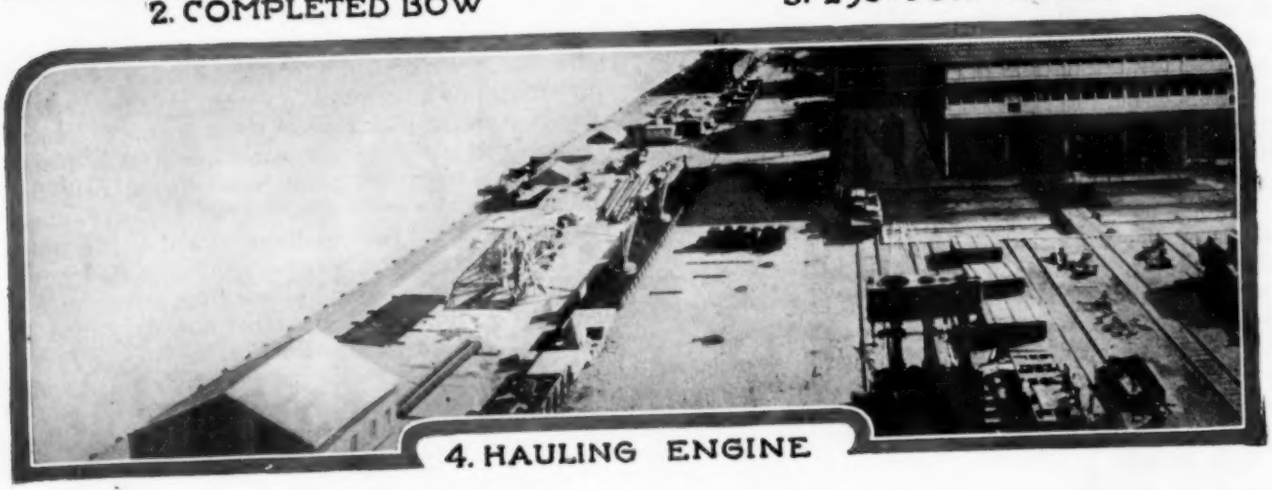
1. DAMAGED BOW



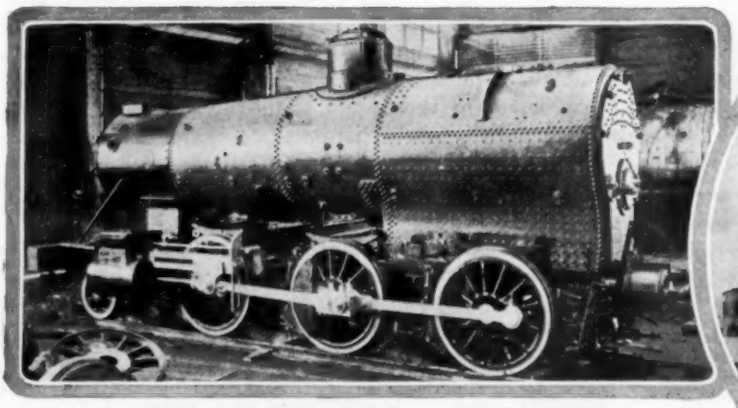
2. COMPLETED BOW



3. 250-TON CRANE

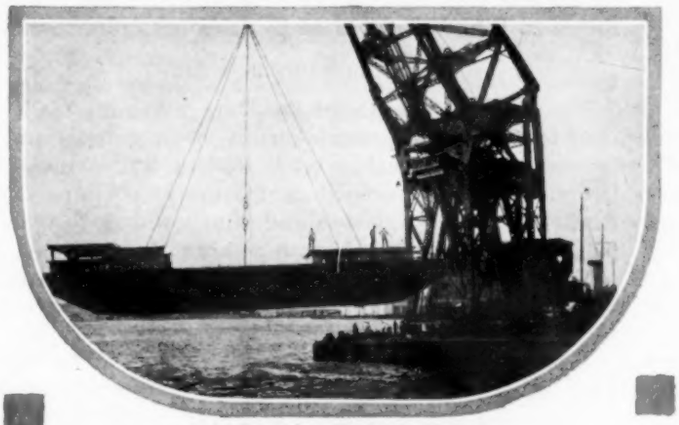


4. HAULING ENGINE

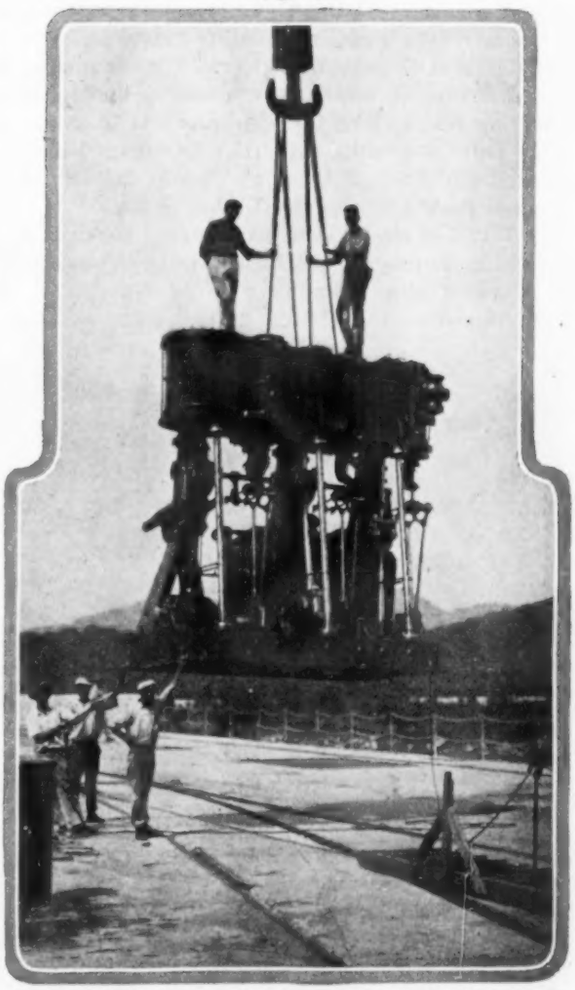


5. AN ENGINE FOR FRANCE

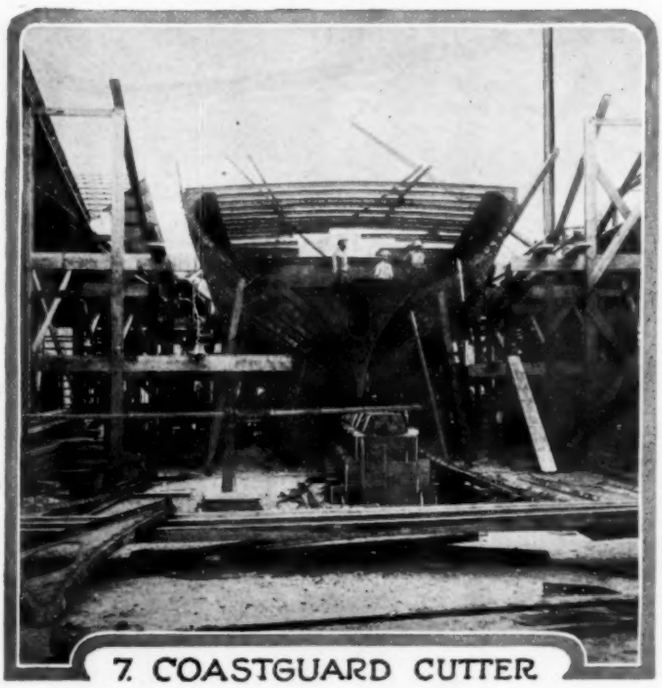
8. LAUNCHING MANHATTAN



6. 120-FT. BARGE



9 ENGINE FOR MANHATTAN



7. COASTGUARD CUTTER

pipe and extensive alterations to increase the coal-carrying capacity of the ship. The repairs to the bow necessitated the renewal of 12 frames from the keel to upper deck on both sides. Four decks had to be renewed from the stem to the collision bulkhead; 27 shell plates were renewed and seven were faired and replaced, these plates being about 22 ft. by 6 ft. by 30 lb. In addition, a new stem 60 ft. long, 14 in. deep and 4 in. thick had to be forged and fitted, and a new hawse pipe, requiring a new pattern, had to be cast, weighing seven and one-half tons.

The total weight of material used in making repairs was over 80 tons, involving in its fitting and erection the work of the following trades: Ship fitters, riveters, calkers, machinists, shipwrights, joiners, electricians, pipe fitters, patternmakers, molders, heavy forgers and riggers. The work had been estimated at over 50 days in a northern drydock. It was completed and the vessel left in just 19 days after her arrival, the men working splendidly all along the line.

Lifting the Main Engines of a Steamer

Fig. 3 shows the large 250-ton floating crane "Ajax" handling one main engine of a 10,000-ton cargo steamer, and Fig. 4 shows this same engine being hauled by a locomotive over rails under the bay of the machine shop, where a 60-ton overhead electric traveling crane will carry it into the erecting floor. The steamship mentioned received a thorough overhauling and renovating, including new boilers, the time required to do the work being only 4½ months. She is now engaged in the important war work of carrying coal to the isthmus and nitrates from Chile to the United States.

In Fig. 5 is one of over one hundred locomotives that have been thoroughly overhauled, retubed, gage changed to standard (the isthmian gage is 5 ft.), and crated and shipped to the United States, many of them for duty in France. During the last few months this work was done at the remarkable rate of 14 locomotives a month, or a little better than one every other working day.

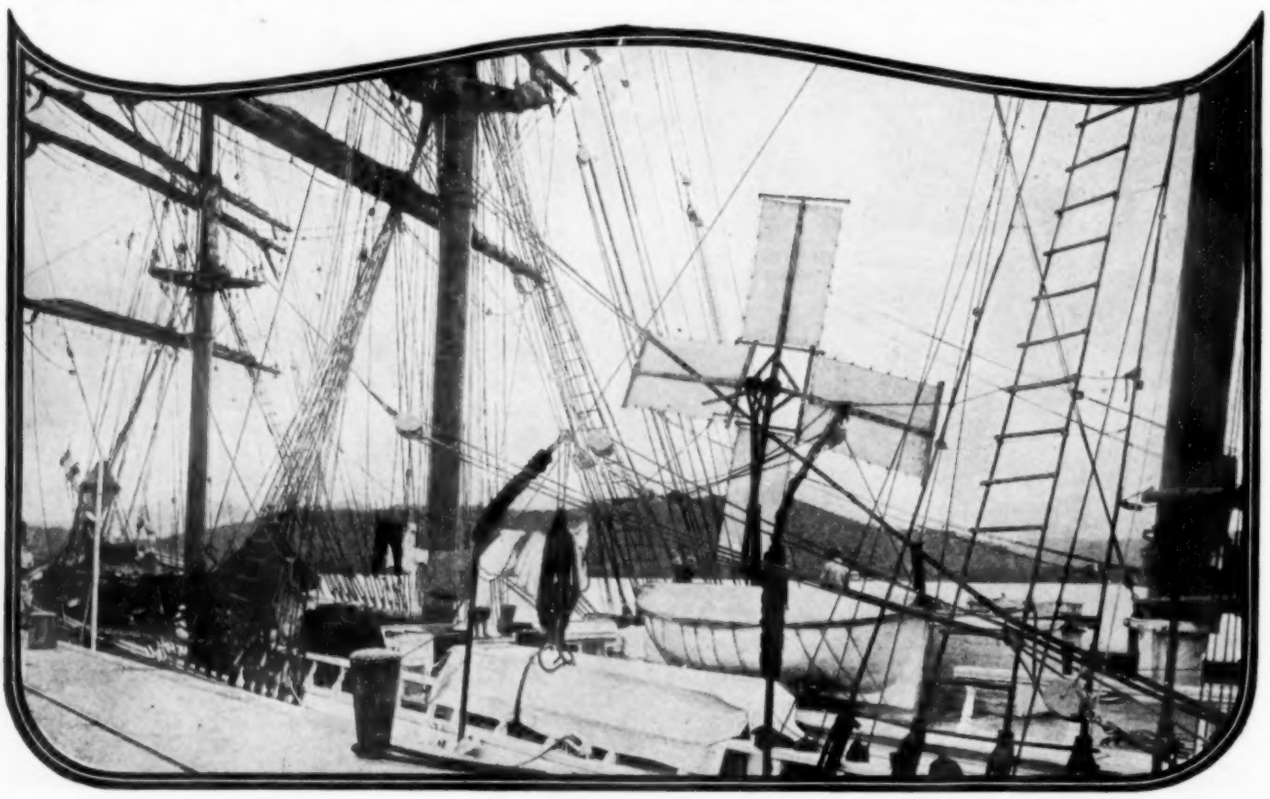
Fig. 6 gives an idea of the launching facilities here. The piece of equipment is simply picked up with the floating crane and there is no further launching troubles. The barge shown is 120 ft. long and was constructed for the use of the Army. It may be seen in process of construction on the dockside in Fig. 4.

The 120-ft. coastguard cutter "Manhattan" being constructed for the Navy is shown in Fig. 7. The launching of this vessel in the same way is shown in Fig. 8. The shops were determined to "do their bit" in ship construction, but were handicapped by lack of launching ways, and hence they could only build a hull capable of being lifted by the crane "Ajax." The weight of the lift shown in Fig. 8 is 210 tons. The vessel is to be used as an ice breaker, hence the peculiar shape of the bow. The engine for this vessel was designed and completed in every detail at Balboa. It is shown in Fig. 9 being lifted by the same crane.

Another Kind of a Job

The shops of the Canal Zone are constantly called upon to do every imaginable sort of job on vessels using the canal. The illustration below shows a large windmill designed and constructed here for use in pumping out the holds of a full-rigged sailing ship, now over 30 years old, on her way to Manila with a cargo of gasoline.

In addition to the interesting engineering problems found in the variety of the work there also arise many phases of the administrative side of the work in dealing, on the one hand, with American, West Indian and Spanish labor, and on the other with captains and chief engineers of almost every nationality, many of them not being able to speak a word of English.



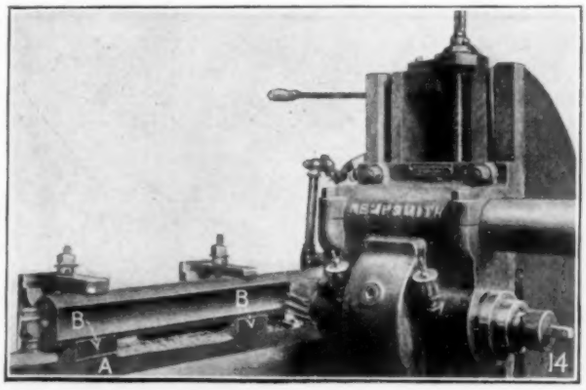
Building the Kempsmith Milling Machine—II

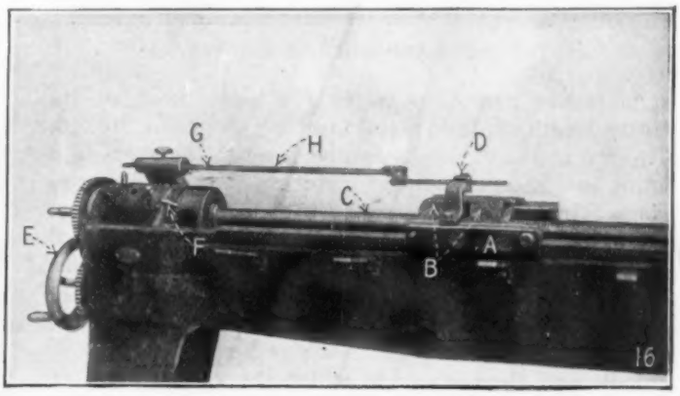
By M. E. HOAG

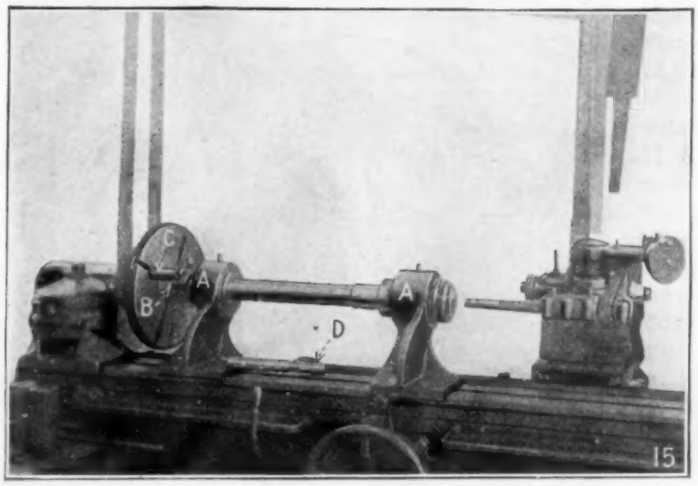
Further details of the construction of the Kempsmith milling machine, including the grinding of journals, the making and testing of feed screws, etc., are here recorded. For the reason that machines of this nature become in a sense master tools, by which other tools are made, it is essential that in their manufacture the utmost accuracy should be maintained.

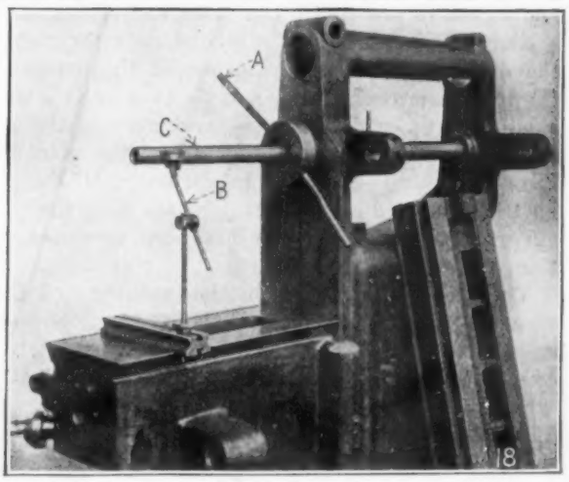
WHILE to the casual observer the overarm of a milling-machine may seem an unimportant part of the equipment it really requires a considerable degree of accuracy in its construction if the machine is to give the best results in practice. Recognizing this fact the Kempsmith shops give as much care to the making and testing of this arm as to any other part. A special grade of machinery steel is used. After cutting the pieces to length they are carefully centered, rough-turned and faced, after which they are ground to exact size. The flat for the clamping screw is carefully milled in a No. 33 frame milling machine as shown in Fig. 14. A long, heavy plate *A* tongued to fit the T-slots in the machine table has three V-blocks cast upon it, two of which may be seen at *B*. The cut shows very plainly the manner in which the milling is done. In making the spindle of the machine the operations, including boring the through and taper holes, threading the spindle nose, grinding all over as well as other minor operations, are more complicated. The cones for the spindle journals are first roughed out nearly to size and heat-treated. They are ground inside to gage, which gives a press fit on the spindle. After being pressed on, the cones are ground in place, thus insuring absolute truth. After all other operations on the spindle are completed the taper hole in the nose is ground, and as this is a very important matter special care is used to secure not only correct size and taper, but to insure its running true. This is accomplished with the grinding fixtures shown in Fig. 15. The two heads *A* are fitted with bearings that are exact counterparts of the bearings in which the spindle will run when assembled in the milling machine and are adjusted to the spindle which is to be ground. A dog *B* and stud *C* in the faceplate of the grinding machine head drive the work while the internal grinding atachment grinds the hole to fit the standard taper plug gage *D*.

The feed screws are milled in a Pratt & Whitney thread-milling machine equipped with a special precision screw, which insures very accurate results. If a screw shows any distortion after milling it is carefully









FIGS. 14, 15, 16 AND 18. OPERATIONS IN MACHINING AND TESTING

Fig. 14—Milling flat on the arm. Fig. 15—Grinding taper in spindle. Fig. 16—Testing machine for lead screws. Fig. 18—Testing alignment of spindle

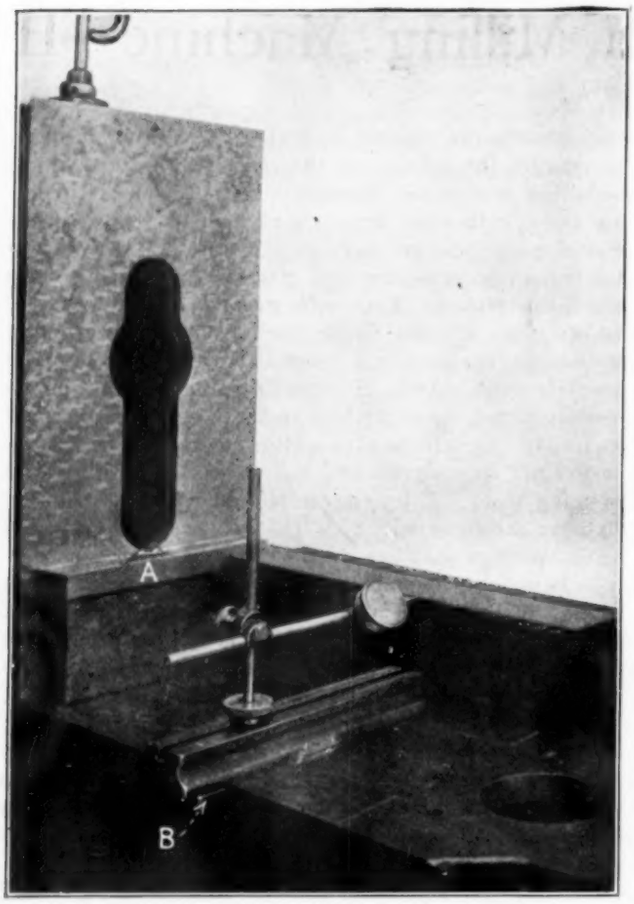


FIG. 17. INDICATING KNEE AND COLUMN

straightened and then tested for lead througout its entire length, in the special machine shown in Fig. 16. The bed of this testing machine is much the same as a lathe bed, except that the ways are flat and the carriage is made a very close fit to insure freedom from vibration, etc. All parts are carefully fitted and scraped. The carriage *A* is fitted with adjustable bronze nuts *B* which receive the screw *C* to be tested. An arm *D* supports a dial indicator directly over the center of the screw. The machine head has a hollow spindle and chuck through which the screw is passed and locked in place. On the outer end of the spindle is a gear that meshes with a second gear through which the machine is turned by means of the handwheel *E*. On the front end of the spindle is a collar, which is graduated to read in inches, and over it the pointer *F*, which is attached to the head of the machine. If the screw is turned by the handwheel until the reading on the collar indicates 3 in. it means that the carriage carrying the dial indicator has been advanced exactly 3 in. from its former position.

The screw *C* is placed in the machine and the carriage *A* advanced until the distance from the indicator finger to the end of the rod *G*, which is supported by a bracket on the head of the machine, is say just 24 in. when measured by a standard end-measuring rod *A*. The collar on the end of the spindle is now set at zero and the handwheel turned until the carriage carrying the dial indicator has been advanced a definite amount as indicated by the graduated collar. By substituting a shorter standard rod in place of the one first used any variations will be disclosed by the difference between the theoretical advance measured by the graduated collar and the actual advance as measured by the rod and dial indicator. These operations are repeated at fixed intervals throughout the entire length of the lead screw *C*, which not only gives the total error but also serves to detect local variations that might occur throughout the length of the screw.

Testing Alignment

When the knee is fitted to the machine column it is tested for alignment in every position. As shown in Fig. 17 the machine column is in a horizontal position with the knee in place and clamped to the ways by the gibs. A steel square *A* is supported at a convenient distance above the column face by wooden blocking. The base of the dial-indicator support rests on the scraped surfaces of the column with the guide block *B* in contact with the V on the column. By holding the stock of the square against the scraped surface of the knee with the edge of the blade in contact with the indicator and sliding the latter back and forth with the block *B* in firm contact with the V it will indicate any variation from square and at the same time detect any high or low points along the V which would not be possible if a wide block *B* were used, as such a block would have too great a bearing on the V. By placing the square in a vertical position any variation from square in the other direction is determined, and by reversing the first test the alignment of the Vs on the knee with the face of the column will be determined. The table

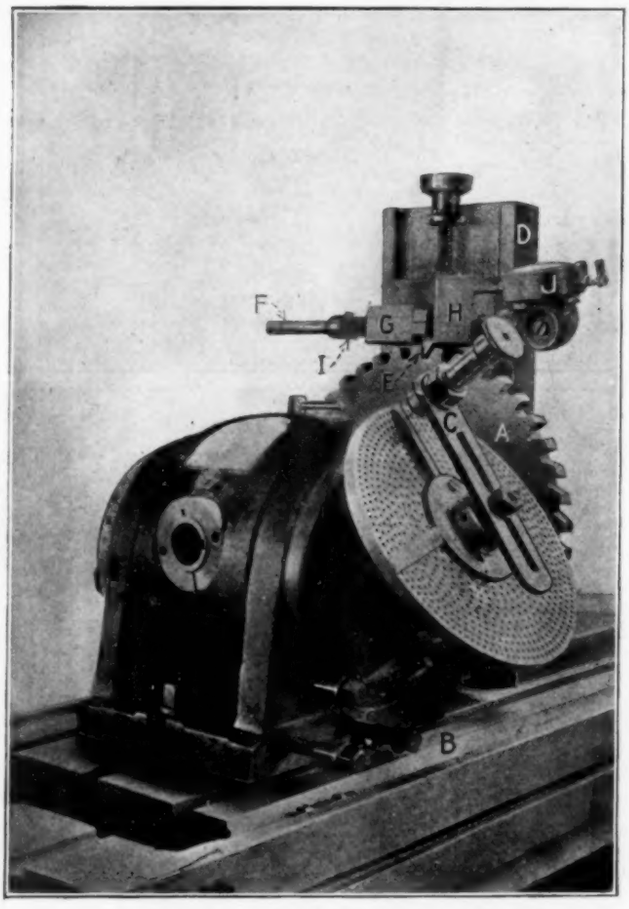
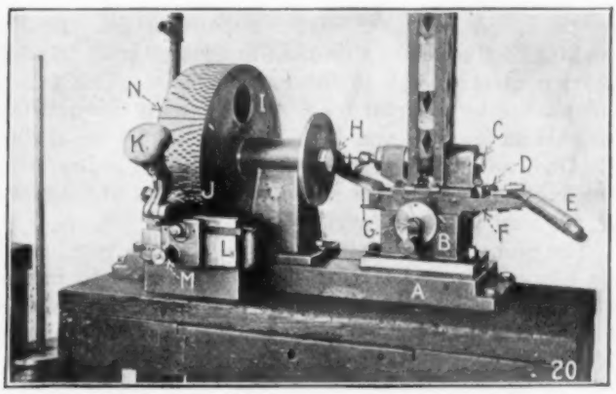
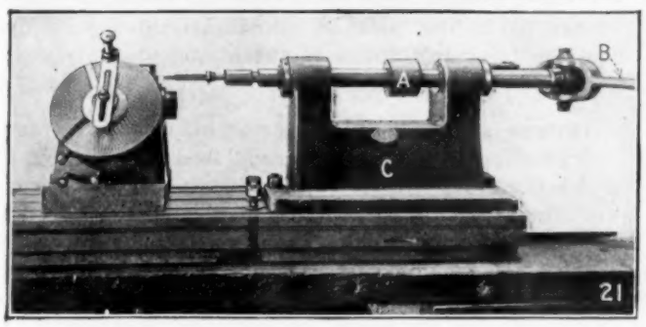
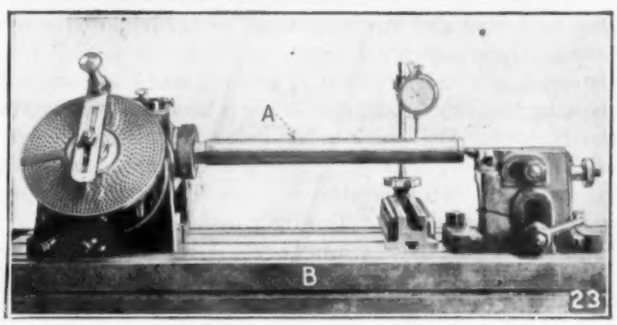


FIG. 22. TESTING INDEX WORM

and saddle are indicated in a similar manner. After assembling and testing the knee and column the spindle bearings are scraped. In testing the spindle a standard hardened and ground taper-shank arbor is placed in the spindle nose and tested in all positions, as shown in Fig. 18, the yoke or wrench *A* being screwed onto the spindle nose in order that it may be easily turned to different positions. By placing the finger of the dial indicator *B* against the under side of the arbor *C* and moving it along its length with the spindle in various positions any variation from parallelism between the spindle and the top of the knee will







FIGS. 19, 20, 21 AND 23. TESTING DIVIDING HEADS AND INDEX PLATES

Fig. 19—Progressive assembling of dividing heads. Fig. 20—Drilling index plates. Fig. 21—Reaming quick index holes. Fig. 23—Indicating head and tail centers

be shown, and by placing the indicator finger against the side of the arbor and sliding the base along the V the alignment of the spindle with the travel of the saddle is determined. Before making these tests the spindle taper and arbor have been indicated and found true. The testing of the machine arm is handled in practically the same way, which assures perfect alignment of its centers or collars with the machine arbors used in regular work, etc.

In making the dividing heads the same unit system of assembling is followed out as described for the machines, involving the use of some interesting testing devices and special fixtures. A general view of one of the assembling benches with dividing heads in various stages of completion is shown in Fig. 19. At the lower end of this bench the heads are given the final tests and inspection.

One of several machines for drilling index plates is shown in Fig. 20. These machines are mounted on wooden benches at a convenient height from the floor and are operated by boys still in their apprenticeship.

The base *A* carries the drilling head *B*, which is driven by belt from a countershaft. The spindle *C* carries a drill chuck on its front end and is supported by suitable bearings in the sliding member *D*, which is advanced to and withdrawn from the work by the lever *E*. A second sliding member *F* is operated by the handle and index plate *G*, and by it the drill is shifted to correct positions for the various rows of holes in the index plate being drilled. On the forward end of this member is a support which carries a bushing *H*, which guides the drill.

The index plate is fastened to the end of the spindle that carries the master index plates *I*, of which there are in this particular case 11. These plates are hardened and ground and the index notches are ground, one edge being radial with the axis of the plate and the other edge beveled so that the action of the locking bolt, which is carried in the piece *J*, is to wedge the plate forward and keep the radial edge of the notch in contact with the bolt during the drilling. The index bolt is operated by the padded lever *K* on which the operator rests his forearm while he turns the plates with his left hand. Correct location of the plunger for the several plates is obtained by sliding the bracket along the plate *L* and locating it by means of the pin *M*, which enters one of a row of holes in *L*.

In assembling the master plates on the spindle they are lined up at one point as shown at *N*. With this fixture and a reasonable amount of care by the operator it is practically impossible to make an error.

After the heads are assembled and tested for correct indexing the quick-index holes in the bronze worm-wheel are finish-reamed true with the index pin hole in the fixture shown in Fig. 21. This fixture is quite simple, the entire equipment, including the head to be reamed, being mounted on a machine table and the spindle *A* driven by a belt from a countershaft. The

lever *B* serves to move the spindle back and forth in the bearings carried by the head *C;* the reamer and shank is held in the front end of this spindle and is supported and guided into the work by it.

After being assembled all of the dividing heads are given a careful inspection and various tests, one of the principal ones shown in Fig. 22 being the test for proper indexing. The master plate *A* has 40 notches and is fastened securely to the nose of the head being tested, which in turn is located on the bedplate *B*. As the worm requires 40 turns of the handle *C* to produce one complete revolution each notch in the master plate tests one turn of the handle. The head *D* is also located on the bedplate *B* and in such a position that the flat surface of the finger *E* is held in contact with the flat portion of the notch in the master plate. This is accomplished by the plunger *F* which passes through the two blocks *G* and *H* and is held in position by the spring *I*. One end of this plunger carries the dial indicator *J*, the finger of which rests against the surface of the block *H*, as seen in the illustration.

The plunger and all its parts are free to turn about its supporting axis so that the finger *E* may be moved out of the notch in the master plate while the position of the latter is being changed. By starting at notch No. 1, setting the dial indicator at zero and then indexing the master plate around, each of the 40 positions may be tested and any variations or accumulated error noted. Upon a printed chart each reading is noted as the work proceeds, so that a visible record is obtained showing the exact condition of each head when it leaves the factory. The quick-index holes are also indicated, and if there is any variation between these and the master plate this variation is also noted. This work is held to very close limits which insure satisfactory results in the finished machine.

The truth and alignment of the taper hole in the spindle is tested with a hardened and ground master arbor and dial indicator as shown in Fig. 23, the first test being for parallelism of the arbor *A*, with the baseplate *B*. Then by indexing the head around, any inaccuracy in the taper hole will be indicated by a rise or fall at the end of the arbor. The arbor must also stand true in all positions with the edge of the central slot in the base *B*. If it does not do so suitable alterations are made in the tongues and grooves in the base of the head.

After these tests have been made and the parts found correct the tailstock center is tested by forcing the center into the center hole of the arbor, when if it does not line up with the head it will cause a movement of the arbor which is at once shown by the dial indicator and the proper corrections made to overcome such error.

The Modern Foreman

BY W. H. ADDIS

The principal quality in a foreman must be his ability to command and retain the confidence and respect of both employer and employee. Without this he is a losing proposition.

As a foreman enters his department for the first time he realizes that he stands in the position of a mediator, or an umpire. The company expects him to deliver its finished product in such quality and quantity that its good name shall be maintained and that its stock shall pay a fair dividend on its departmental investment. To achieve these results he must have the friendship, the hearty coöperation and the good-will of his men; he must play the game fair, both for the company and for his men. To the men he stands for the company; to the company he is the mouthpiece and the leader of his men. Every word, every promise made in the name of the company must be faithfully kept, for generally it will be found that it was because of the lack of confidence and coöperation by his associates that his predecessor failed.

Improve working conditions the first thing. Strive to establish better order. For the first few days on the job be a good listener. There will be many stories heard of past grievances. Some will point out grievous errors in the former management. I recall a case of injustice that had been done the men by a foreman who promised them an increase in wages and then let the matter drag for weeks. In this case every man was given all back pay as well as the promised raise. The company's word was made good.

A man must have some incentive besides his pay. He must be made to feel that he is a potential success; that there is an opportunity for him to advance in ratio to the effort he puts forth to increase his efficiency. This brings us to the question of educational supervision and the foreman's duties in the matter.

OPPORTUNITY FOR MENTAL IMPROVEMENT

If there is anything that the man in the shop respects it is intelligence. A real leader will lead both in thought and action. He will tactfully ascertain the educational advantages each workman has had, and he will plan to train and instruct him from his particular vantage point. This may be done by means of literature dealing with the trade. In the larger cities night schools offer an opportunity for mental improvement, and the Y. M. C. A. has an educational department that has started many a man on the road to success. The work the correspondence schools are doing ought also to be mentioned. These institutions will gladly coöperate with foremen by informing them of the progress the student is making. Lastly the foreman must constantly strive to devise better methods of production. Tell the boys what it is hoped to achieve in the way of production; ask them to play the game. Set a goal and keep them daily informed as to their progress. Men like to be appreciated. When they make a good record tell them how much their team work is valued.

More than all the other opportunities that come to a foreman is the intimate personal service he may occasionally render to his men. Enter into all the little needs and troubles of your fellows in the shop. If you cannot help them in other ways, sympathy, which is rare, is often highly prized.

Never let a man leave you feeling that you have done him an injustice. When discipline is necessary be sure you are right and that no personal feelings enter into your decision. If you must discharge a man for incompetency, carelessness or disobedience call him into the office, talk it over quietly and ask him what you really ought to do. I have found that in most cases the offender will deliberately punish himself by leaving.

How the 155-Mm. Howitzer Is Made—IV

By J. V. HUNTER
Western Editor *American Machinist*

Machining the breech section of the gun requires great care not only because some very close and accurate work has to be done, but because this work represents the final finishing of the gun body, and any mistakes that might be made would spoil the gun, so that much costly work and material would have to be scrapped.

AFTER the hinge hole has been drilled and reamed there is a further series of operations on the breech end of the body, many of which are gaged from the location of the hinge hole. In connection with the machine operations there are a number of hand-finish operations required from time to time to chip or file corners and other points that cannot readily be reached by the milling cutters.

The further series of operations on Part 3 are:

Operation 27.—Profile angular cut on top of hinge lug. Machine—No. 5119. Type—Beaman & Smith horizontal boring machine fitted with profile arrangement. Tools—Gages, two lip end mills. Coolant—Compound solution occasionally used.

Operation 27A.—Finish right-angle surfaces on hinge lug. Machine—No. 5538. Type—Gould & Eberhardt shaping machine. Tools—Shaping machine; gages. Coolant—None.

Operation 27B.—Mill T-slot. Machine—No. 5122. Type—Beaman & Smith horizontal boring machine. Tools—End mills; holding fixture. Coolant—Seldom used.

Operation 28.—Mill dovetail slot. Machine—No. 5118. Type—Beaman & Smith horizontal boring machine. Tools—Dovetail cutting mills; gages. Coolant—Cutting oil.

Operation 29.—Drill and tap all holes. Machine—Nos. 5107 and 5108. Type—3-ft. Fosdick radial drilling machine. Tools—Drills, drilling fixtures and jigs, taps, locating gages. Coolant—Cutting solution.

Operation 30.—Chase thread. Machine—Nos. 5017 and 5018. Type—36-in. by 18-ft. American lathe. Tools—Lathe tools; thread gages.

Operation 31.—Machine at sides of threaded section for relief in turning. Transformation—Fig. 63. Machine—No. 5432. Type—24 in. by 12 ft. Ingersoll milling machine. Tools—Work-holding fixtures; formed milling cutters; gages. Coolant—1 to 12 solution cutting compound.

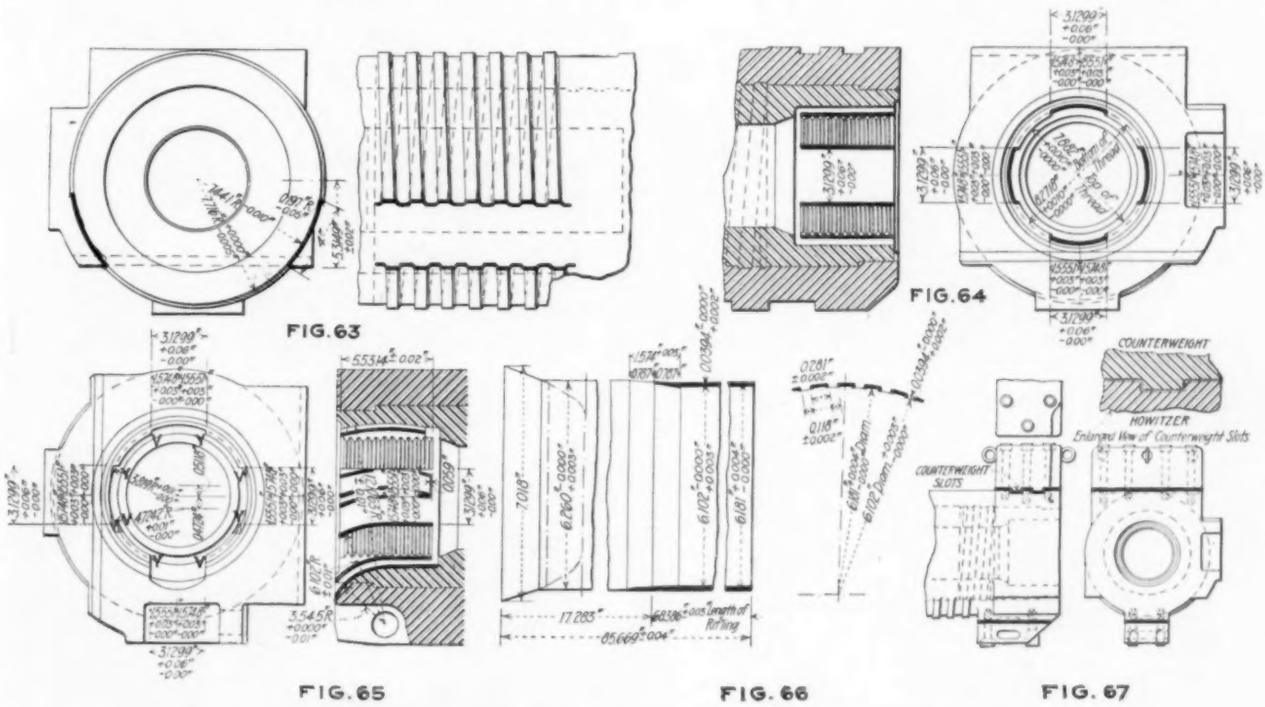
Operation 32.—Finish-turn thread-clearance section and face back of breech.

Operation 33.—Slot sectors in breech recess. Transformation—Fig. 64. Machine—No. 5509 Cincinnati shaping machine; Nos. 5525 and 5526 20-in. Gould & Eberhardt shaping machines. Tools—Special work-holding fixture; gages. Coolant—None.

Operation 34.—Machine swing clearance in breech. Transformation—Fig. 65. Machine—No. 5536. Type—Special design of swing shaping machine. Tools—Gages. Coolant—None.

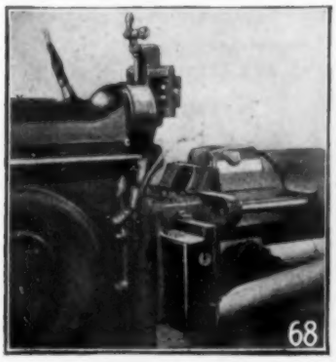
Operation 35.—Rifle gun barrel. Transformation—Fig. 66. Machine—Nos. 5513, 5514, 5515, 5516 and 5517. Type—38 in. by 24 ft. LeBlond rifling machine. Tools—Rifling head and cutters. Coolant—One part lard oil to 5 parts kerosene.

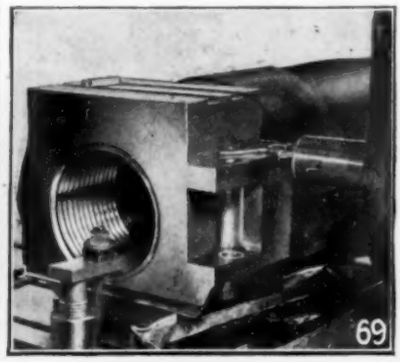
Operation 36.—Cut off and face muzzle end to a length. Machine—No. 5004. Type—27 in. by 14 ft. Reed-Prentice lathe

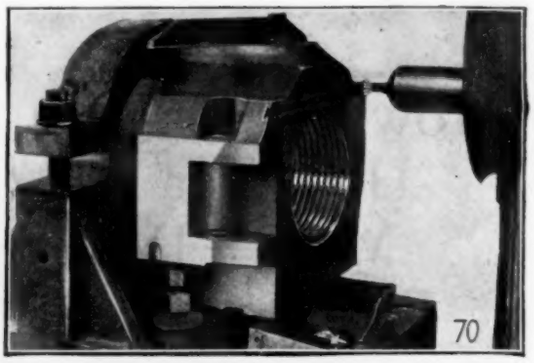


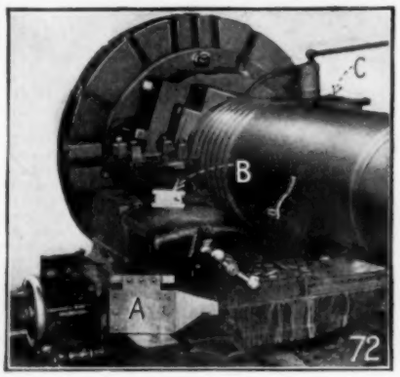
FIGS. 63 TO 67. TRANSFORMATIONS OF VARIOUS OPERATIONS

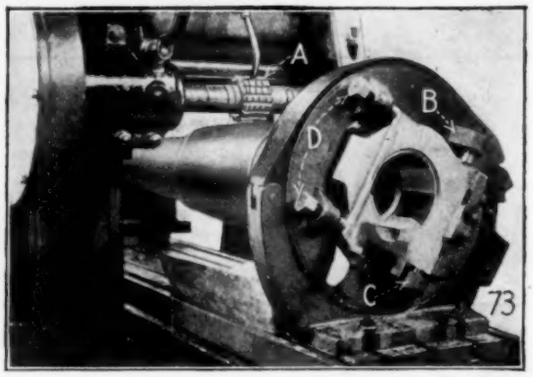
Fig. 63—Transformation for operation 31. Fig. 64—Transformation for operation 33. Fig. 65—Transformation for operation 34. Fig. 66—Transformation for operation 35. Fig. 67—Transformation for operation 38





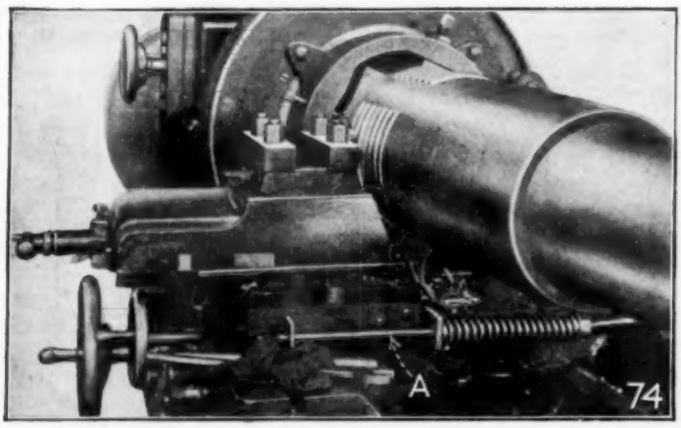


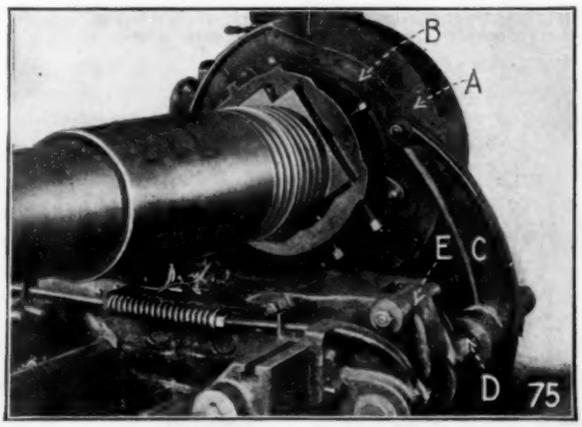


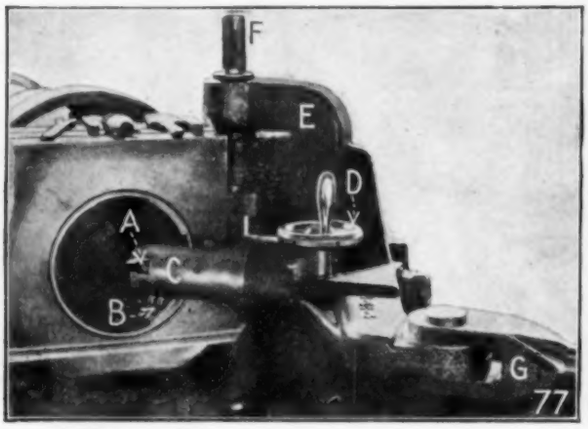


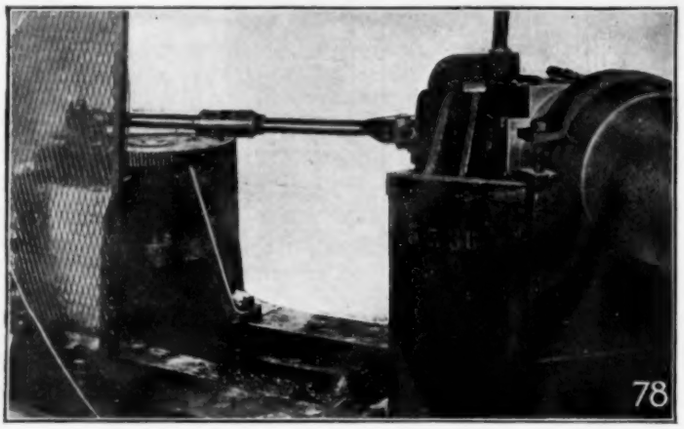
FIGS. 68 TO 73—MILLING AND SHAPING OPERATIONS ON BREECH AND BODY. FIGS. 74 AND 75—SIDE AND REAR VIEWS OF THE JUMP LATHE. FIGS. 77 AND 78—SHAPING SWING CLEARANCE

Fig. 68—Shaping part of hinge pocket. Fig. 69—Milling a T-slot. Fig. 70—Fixture and cutters for milling a dovetail slot. Fig. 71—A counterboring operation. Fig. 72—Cutting threads on the body. Fig. 73—Cutting relief on threaded section. Fig. 74—The tool slide. Fig. 75—The actuating mechanism. Fig. 77—Fixture and tools for cutting the swing clearance. Fig. 78—Driving rig for swing-clearance cutting attachment







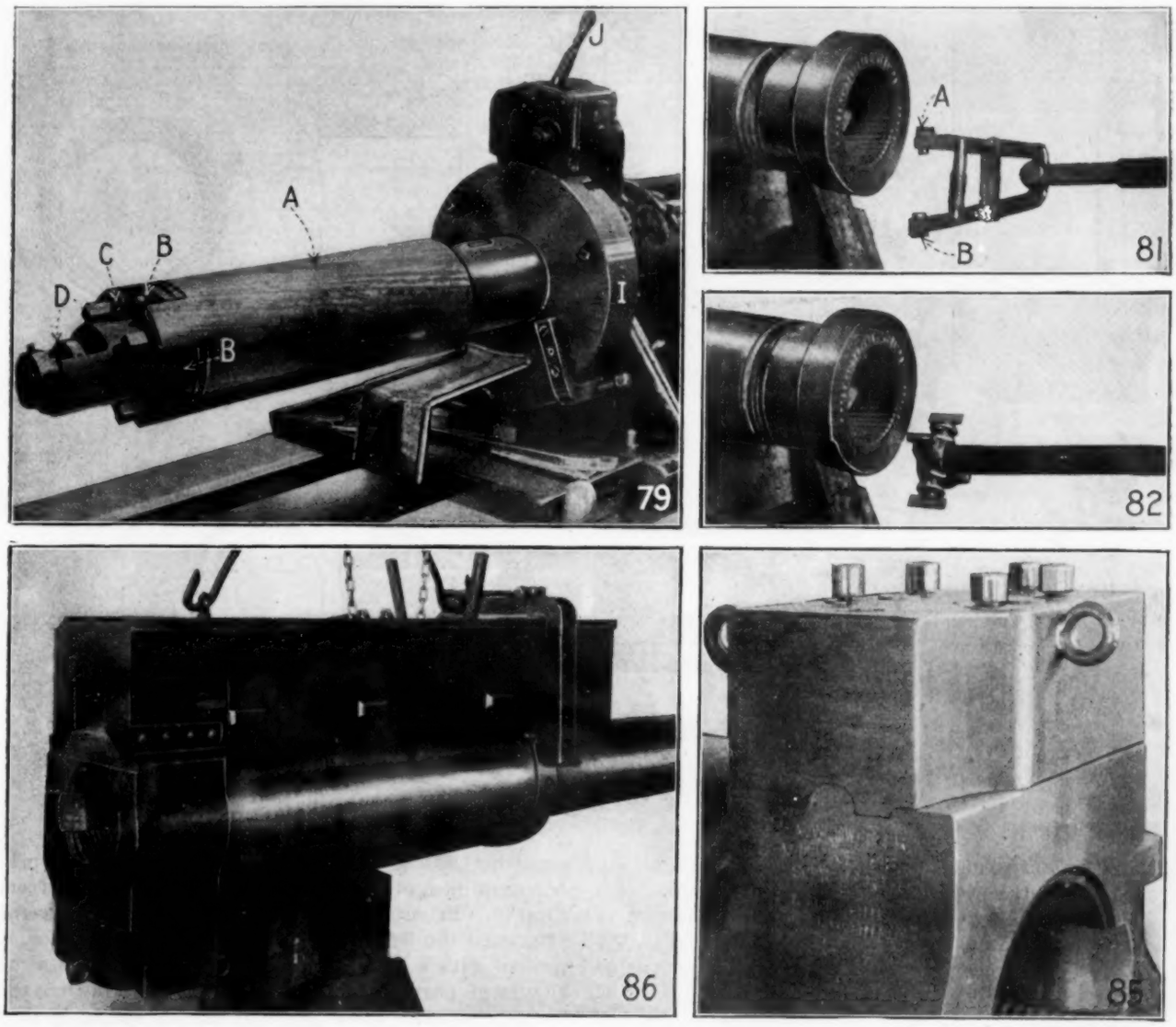


Operation 37.—Mill relief on muzzle end of gun. Machine—No. 5432. Type—24 in. by 12 ft. Ingersoll milling machine. Tools—Special formed cutters.
Operation 38.—Assembling of bridle and counterweight on gun body. Transformation—Fig. 67.
Operation 38A.—Mill screw heads flush. Machine—No. 5138. Type—Beaman & Smith horizontal boring machine. Tools—Milling cutters.
Operation 39.—Hand work; assembling; marking quarter lines; leveling plates and lettering on gun body.
Operation 40.—Final inspection.
Operation 41.—Painting.
Operation 42.—Inspection.
Operation 43.—Boxing.
Operation 44.—Shipping.

The milling cut on the interior of the hinge pocket is a roughing one. This is now followed by a shaping cut on the right angle surfaces, as is illustrated in Fig. 68. Only one side of the dovetail slot is cut at a time, a second cut being made for the opposite side.

All the drilling operations on the breech end are performed on radial drilling machines. One operation—counterboring—is illustrated in Fig. 71, to show the type of jigs that are used for this work. In the drilling operations the body is carefully leveled so that no trouble will result in the alignment of the holes. The tapping arrangements are similarly performed on the same basis by the use of a tapping attachment.

Cutting the thread in operation 30 is performed on a 36 in. by 18 ft. lathe, Fig. 72. The gage for position-



FIGS. 79, 81, 82, 85 AND 86. RIFLING OPERATIONS, COUNTERWEIGHT FITTING AND SURFACE PLATE FOR FITTING CARRIAGE BEARING

Fig. 79—The rifling head. Fig. 81—Tool for filing the grooves. Fig. 82—Lap for polishing the grooves. Fig. 85—How the counterweight is attached. Fig. 86—Surface plate for fitting carriage bearing

In cutting the T-slot the method is shown in Fig. 69, in which at this particular instant the end mill used is making the first cut. This is followed by a T-slotting cutter, which makes the final cut at this point. The milling of the 13-deg. angle on the inside of the hinge lug is performed by the aid of a profile form.

The holding fixture, gages and dovetail milling cutter for operation 28 are easily understood from Fig. 70.

ing the thread on the body is shown at *A*. The thread gage is shown at *B*, and a third gage used in connection with this work is lying on top of the howitzer body at *C*. The thread is cut entirely around the body, but is all later removed with the exception of a strip about 8 in. wide on the lower section, which is used for a rack in connection with adjustment of the gun on the gun carriage.

The removal of the surplus thread is done in a lathe of the "jump" type, but before this is done it is necessary to make clearances for the lathe tool to begin and end the cut. This is done in a milling machine, Fig. 73, using a cutter formed to the radius at the root of the thread as shown at *A*. The fixture for this operation has lugs at *B* and *C* for the alignment of the body in the proper position. The screws *D* are for tightening the body in the fixture.

Turning off the excess thread in the jump lathe, which was especially constructed for this particular operation, is shown in Fig. 74. The jumping feature of the tool carriage is aided by the spring *A* at its base. This is in turn controlled by lever mechanism at the rear of the lathe bed, which is shown in Fig. 75.

The controlling feature of this device is the cam *A* bolted to the faceplate of the lathe. Running in the groove *B* is a roller on the lever *C*. Motion imparted to this lever by the cam is also imparted to lever *E* through shaft *D*. Lever *E* being pivoted to the tool block gives to it a reciprocating movement timed by the cam.

Interrupting the threads in the breech is done on a shaping machine. Suitable templets are used for laying out the work, and a special work-holding fixture is provided for the necessary partial revolution of the gun body during the removal of each section. Details showing the removal of these sections will be found in the line drawing, Fig. 76.

A machine for cutting the swing clearance in the breech end of the gun is shown in Fig. 77. The cutting tool is seen at *A* being held by the setscrews *B* in the bar *C*, which can be turned through the required arc by means of the handwheel *D*. The whole arrangement is attached to the yoke *E* and the cut is made by swinging it about the pin *F* by which it is pivoted to the hinge lugs of the gun. Reciprocating motion is transmitted through the connecting-rod *G* from a power crank shown in Fig. 78 at the left. This view shows the whole machine from the rear.

Rifling the barrel is rather more simple than that required for the large majority of heavy rifles and field guns because the rifling in the howitzer is at a constant degree of twist throughout its entire length; also the shortness of the howitzer in comparison with rifles somewhat lessens the problem of handling this work. A general idea of the rifling head may be obtained from Fig. 79. In cutting position the bar is fed forward or toward the left of the reader. The body portion is covered with a bronze sleeve *A*, which serves the same alignment purposes as does the wood packing on the boring reamers. There are four cutters spaced 90 deg. apart at *B*, each of which cuts two grooves simultaneously, so that the rifling head is actually cutting on eight grooves at each forward stroke. Pipes at *C* feed a constant heavy stream of coolant on the cutter and wash the chips freely from the barrel.

Adjustment of the cutters is made by the capstan nut *D*. The details of the rifling head can be better understood from the drawing Fig. 80. At the end of the head is a plunger *E*. When the head has been pushed through to the further end of the barrel the plunger comes in contact with a fixed stop that pushes it back into the head, causing a release of the cutting

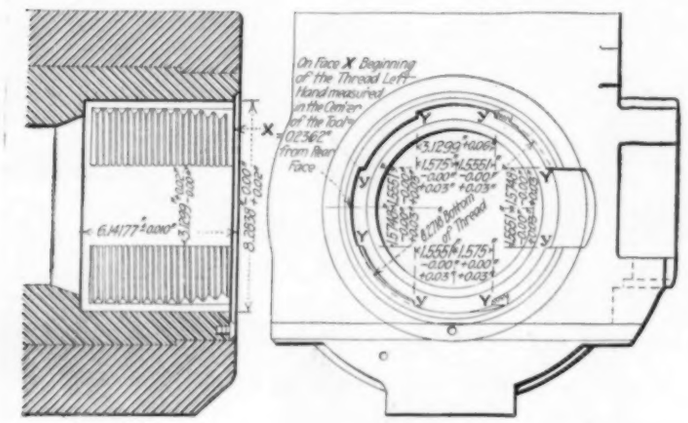


FIG. 76

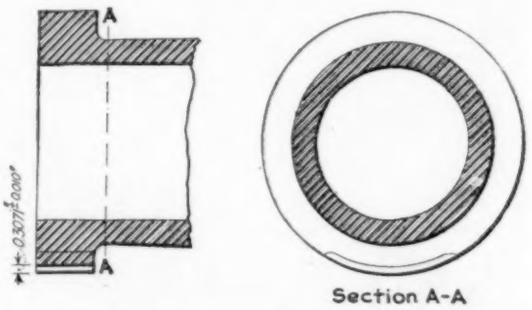


FIG. 84

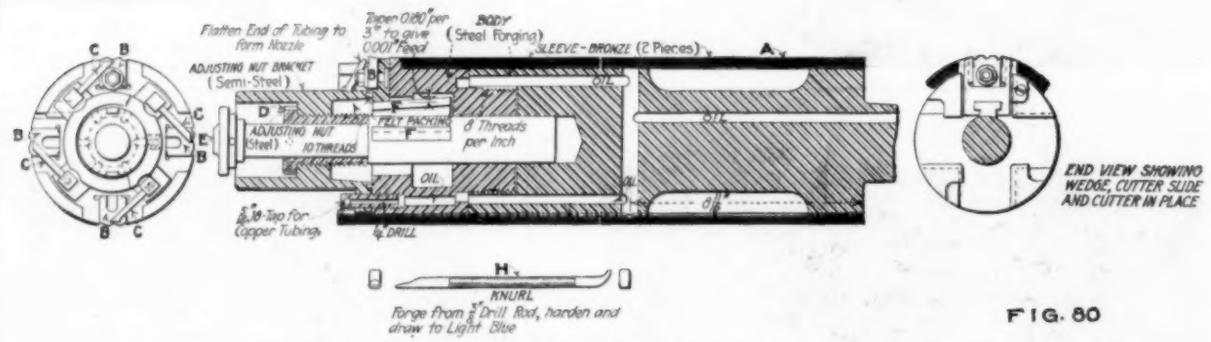

Flatten End of Tubing to Form Nozzle
Taper .080" per 3" to give .001" Feed
BODY (Steel Forging)
SLEEVE-BRONZE (2 Pieces)
ADJUSTING NUT BRACKET (Semi-Steel)
ADJUSTING NUT (Steel)
10 THREADS
FELT PACKING
8 Threads per Inch
OIL
Tap for Copper Tubing
DRILL
KNURL
Forge from Drill Rod, harden and draw to Light Blue
END VIEW SHOWING WEDGE, CUTTER SLIDE AND CUTTER IN PLACE

FIG. 80

FIGS. 76, 80 AND 84. INTERRUPTED THREAD, RIFLING HEAD AND RELIEF ON MUZZLE

Fig. 76—Details of interrupted thread. Fig. 80—Details of rifling head. Fig. 84—Relief on the muzzle

blades for the return stroke. The operation of this release is by the T-shaped tapered keys *F* that are partially let into slots in the inner end of the plunger. The inward movement of the plunger causes the keys to close the cutters together radially. After each return stroke of the rifling head the plunger is pulled out by the small bar *H* and the adjusting nut *D* is set up for the next cut. The flow of coolant is automatically cut off at the end of the cutting stroke, so the operator has not this to contend with while setting his cutting blade. An average of eight cutting strokes is required to complete each set of grooves. The cutting stroke requires one minute, and the return stroke 30 seconds. The coolant used for this work is a mixture of one part of lard oil to five parts of kerosene.

Since the rifling head only works on eight out of the total of 48 grooves in the barrel at each setting it follows that six settings will be required, and these are provided for by the indexing head at *I*, Fig. 79, the control for which is by the lever *J*.

There are always numerous small imperfections and rough spots in the rifling, which have to be later cleared out by hand-finishing operations. One of the devices used for this is the filing device fastened to the end of the pole that is shown in Fig. 81. A special file is clamped on the arm at *A*, of a width to fit the grooves of the rifling, and on the other arm *B* is a corresponding wood block so that no cutting will occur at that point. The device is sprung together in order to insert it into the bore, and a spring across the jaws provides the necessary pressure for the file. By this device the operator is enabled to reach any point in the bore.

The finish required in the grooves is of the highest grade possible, and after filing it is customary to use the lead lap shown in Fig. 82. The device, which is also mounted on the end of a pole, has four lead laps at 90 deg. from each other. By polishing with this device the operator is enabled to bring the grooves to a very high grade of finish. The chalk marks which the workman put on the muzzle indicate the grooves upon which he has completed his work. After the finishing work on the grooves has been completed they are subjected to a very careful inspection, including star-gaging. An inspection of the powder chamber is conducted at the same time. Both of these inspections are recorded on the form shown in Fig. 83, which is similar to the forms which were used for star-gaging the jacket, and also the tube, before and after shrinking. After the muzzle end of the gun has been cut off and faced to the required length the gun is placed in a 24 in. by 12 in. milling machine, and by means of a formed cutter the relief is milled on the muzzle end of the gun. The cut made in this operation is shown in Fig. 84. The gun body is now ready for assembling the bridle and counterweight, which are fastened by means of special screws, the heads of which are afterward cut off. A view of the method of fastening the counterweight is shown in Fig. 85, in which the heads of five of these screws may be seen standing above the top surface of the counterweight. After the heads have been cut off, the part of the bodies in the counterweight are peened in order to insure tightness and then milled flush with the surface of the counterweight and bridle.

LANDS C-75 **GROOVES**

155 M/M HOWITZER No. 536 MODEL 1918 HEAT No. JACKET B2 58F2 (S) HEAT No. TUBE M354 (S)

INCHES FROM MUZZLE	LANDS ⊕	LANDS ⊖	LANDS MEAN	GROOVES ⊕	GROOVES ⊖	GROOVES MEAN	INCHES FROM MUZZLE	LANDS ⊕	LANDS ⊖	LANDS MEAN	GROOVES ⊕	GROOVES ⊖	GROOVES MEAN
Set	6.102			6.181			34	+.002	+.002				
0	+.015	+.0025		+.001	+.0015		35	"	"		+.002	+.002	
1	"	"		"	"		36	"	"		"	"	
2	"	"		+.002	"		37	"	"		"	"	
3	+.002	+.002		"	"		38	"	"		"	"	
4	"	"		"	"		39	"	"		"	"	
5	"	"		+.003	"		40	"	"		+.0015	"	
6	"	"		"	"		41	"	"				
7	"	"		"	"		42	"	"				
8	+.015	"		"	"		43	"	"				
9	+.002	"		"	"		44	"	"				
10	"	"		"	"		45	"	"				
11	"	"		"	"		46	"	"		"	"	
12	"	"		"	"		47	"	"				
13	"	"		"	"		48	"	"				
14	"	"		"	"		49	"	"				
15	"	"		+.0025	+.002		50	"	"		"	"	
16	"	"		"	"		51	"	"				
17	"	"		"	"		52	"	"				
18	"	"		"	"		53	"	"				
19	"	"		"	"		54	"	"		"	"	
20	"	"		"	"		55	"	"				
21	"	"		"	"		56	"	"				
22	"	"		"	"		57	"	"				
23	"	"		"	"		58	"	"		"	"	
24	"	"		"	"		59	"	"				
25	"	"		+.0025	+.0025		60	"	"			+.0025	
26	"	"		"	"		61	"	"				
27	"	"		"	"		62	"	"				
28	"	"		"	"		63	"	"				
29	"	"		"	"		64	"	"				
30	"	"		"	"		65	"	+.0025				
31	"	"		"	"		66	"	"				
32	"	"		"	"		67	+.002	+.0025				
33	"	"		"	"		68				+.001	+.0015	

POWDER CHAMBER

INCHES FROM BREECH	⊕ 6.2596	⊖	MEAN	INCHES FROM BREECH	⊕	⊖	MEAN	INCHES FROM BREECH	⊕	⊖	MEAN
7 +	+.003	+.003		13	+.0005	+.005		19	+.001	+.005	
8	+.002	+.002		14	"	"		20	"	+.001	
9	.0015	+.0015		15	"	"		21	"	+.001	
10	+.0015	"		16	+.001	"		22	+.0015	+.002	
11	+.001	+.001		17	"	"		22 +	+.002	+.002	
12		+.0005		18	"	"					

FORCING CONE — GAS CHECK SEAT

A. B. S. & F. CO. INSPECTION BY ✓ Bore char has been tapped

U. S. INSPECTION BY ✓ DATE 6/15

A. B. S. & F. CO. FORM F-081

FIG. 83. INSPECTION REPORT OF RIFLING AND BORING POWDER CHAMBER

A great deal of hand work is required in the final finishing of the breech end of the gun and the breech mechanism, such as chipping, filing and polishing. The threads in the breech must have their corners relieved approximately $\frac{1}{4}$ in. in order that there will be no tendency for catching or binding when the breech block is rotated. The gun must be placed on an accurately leveled surface plate, and after it has been carefully leveled thereon the quarter lines indicating the exact center of the bore are marked on both the breech and on the muzzle ends.

On the top of the counterweight are placed two leveling plates made of german silver. These are used in connection with setting the sight on the gun when it goes into service and for adjustment purposes of the sight while the gun is in active service.

The gun body must have a perfect fit on certain portions of the carriage, and for this purpose it is fitted to the gage shown in Fig. 86. The gun is turned upside down across the trestles as shown, and the sleigh gage, which has previously been coated with prussian blue, is laid in position and carefully rapped down with wooden mallets. The bridle pin is also put through in place in order to insure that the bridle-pin hole is perfectly in line and of exact size. After removal of the gage the high spots, as indicated by the prussian-blue marks, must be filed and scraped and the gage refitted until a good bearing is obtained. The holding-down strap, which may be seen at the right end of the gage, is also fitted at the same time in order to insure that its holes will match perfectly those in the gun carriage.

Draftsman or Engineer?

BY HARRY SENIOR

E. H. Michaelis, in an article on page 77 of the *American Machinist*, comes dangerously near the truth in his views as to what constitutes an engineer when he says that the requisite knowledge "consists of two essential parts, one the theoretical and scientific and the other the practical shop knowledge." The only thing that saves him from going plumb into the bull's-eye is his later asseveration that "a college education is not necessary—any ambitious man with a little money can become as good a designer as ever graduated." He also says that "any dub can do the work of a so-called draftsman."

It is to the two latter statements that I take exception, for Mr. Michaelis seems to imply that any old "dub" who can become a "so-called" draftsman may also become an engineer as "good as ever graduated," the requirement being a little money and a stock of ambition.

The first part of the first statement means, I think, simply that the same degree of education acquired outside of a college would not be a college education, and with this view I have no quarrel, as it is only a matter of nomenclature. I have always maintained that the items of knowledge possessed by an engineer are to him exactly what the tools in his kit are to a draftsman or a toolmaker, and the manner or place of acquiring them is of no more importance to the former than it is to the latter whether his T-square and compasses were made by Keuffel & Esser or Theo. Alteneder or his micrometers by Brown & Sharpe or Starrett; but the kind of education is as arbitrary and its degree as important (and then some) to the engineer as the nature and extent of his kit is to the worker.

It may be said that a draftsman does not have to have an expensive lot of tools in order to be a skillful draftsman, but nevertheless it cannot be gainsaid that he could not accomplish much in the way of drawings without them; neither could he have become proficient if he had never had them. The engineer and draftsman alike must first acquire tools, and then by practice with them become proficient in using them, the principal difference being that the latter can buy, beg or steal his tools, and in case of temporary hard luck can "hang them up" with "Uncle" and borrow more to do his work with, while the engineer fills his "kit" with the tools of his trade only at the expense of hard work, and once having acquired them can neither lend, sell nor mislay them—he can part with them only by the forgetting process, and he cannot add to them by borrowing.

This brings me to the second point at issue: "Any ambitious man with a little money" and the desire to do so can buy a draftsman's or toolmaker's kit, and the same requisites will supply the candidate for engineer with the necessary education; but right here Mr. Michaelis and I begin to disagree. No dub, even though he owns a year's output of the world's best tool factory, will ever be a draftsman or toolmaker (the chances are, however, that he will never know this); neither will he be an engineer though he absorbs so much academic information that he makes a noise like a football train pulling out of New Haven station.

To attain proficiency in the use of their new possessions both engineer and workman must put them to practical use; they are of no value packed away. Each must become so accustomed to applying the proper tool to its individual purpose that its use becomes second nature; must know just what each will accomplish, and whether or not it is working properly. Each must respect the limitations of his tools and check them with other tools until they respond to the dictates of his brain as subconsciously as the fingers of the violinist follow through the same medium the score.

Years ago there was considerable discussion in the columns of the *American Machinist* anent the relative qualifications of the "born mechanic" and one who just "learned his trade," the advocates of the latter overlooking the fact that not even the born mechanic himself considered himself a finished product until he had passed a little way through the period of evolution that was the sole reliance of the mechanic by education.

I have no wish to reopen this ancient controversy, but it is my personal conviction that to be a successful mechanic, engineer, musician, artist or what not the candidate must bring to the beginning of his educational period, whether the way lies through shop, drafting room, college or studio, that impalpable, inexplicable something called "genius" which if not inherited can never be attained.

Two persons may aspire to play the violin. They may start at the same time and in the same conservatory; may study the same lessons under the same tutors; may devote to their work the same number of hours a day for the same number of years. In the end the one with genius is a violinist, the other a fiddler.

Copper-Pipe Smithing in the Sun Shipyard

By E. A. Suverkrop, Associate Editor, American Machinist

Considerably more steel piping is used in marine work in the United States than in Europe. There are, however, a great number of copper pipes used for marine engine and boiler installations. These require in their production the employment of skilled pipe benders and coppersmiths.

THE smaller pipes for engine work in shipbuilding are usually made from solid-drawn pipe bought in the open market. Before bending, the pipes are filled with rosin, and when the rosin has set the bends are made in the usual way with a bending machine usually equipped with grooved rollers operated by levers. The methods and machines employed in making such bends have been fully covered in previous articles in the *American Machinist*, so there need be no recapitulation of them. In the headpiece is shown a part of the outside storage space for the smaller sizes of copper pipes that have been bent to templet and are ready to have the flanges secured on them. The templets used for this work are made of iron rod, the size of which is determined by the stiffness necessary to retain its form while being handled in the bending shop. It is not intended to go deeply into the art of coppersmithing as practiced in the shipyard copper shop, but a few examples of the procedure when large pipes or abrupt bends are made may be of interest. In Fig. 2 is shown a partly finished main-exhaust pipe 22 in. diameter. This pipe leads from the low-pressure cylinder to the condenser. After the engine and condenser are installed on shipboard the carpenter gets out his templet for the pipe *A*, Fig. 2. This templet is shown at *B* in Fig. 2 and also in Fig. 3. The two wooden flanges *B* are bored for bolt holes and bolted in place on the low-pressure cylinder and condenser respectively. The carpenter then sets in the boards *C*, and at each end the braces *D* are securely fastened to *B* and *C* so that the flanges *B* will retain their position. The bolts securing *B* to the high-pressure cylinder and condenser are now removed, and the templet carefully lifted out and taken to the copper shop. Here the rough wooden platform *E*, Fig. 2, is laid down, and on it with the aid of the templet *B* the two dum-

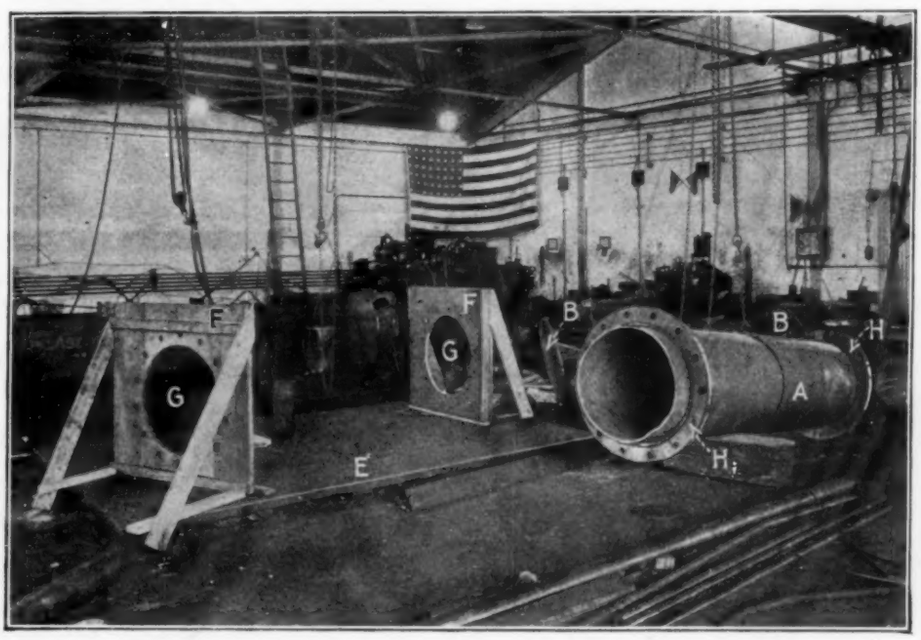


FIG. 2. FITTING AN EXHAUST PIPE TO ITS FLANGES

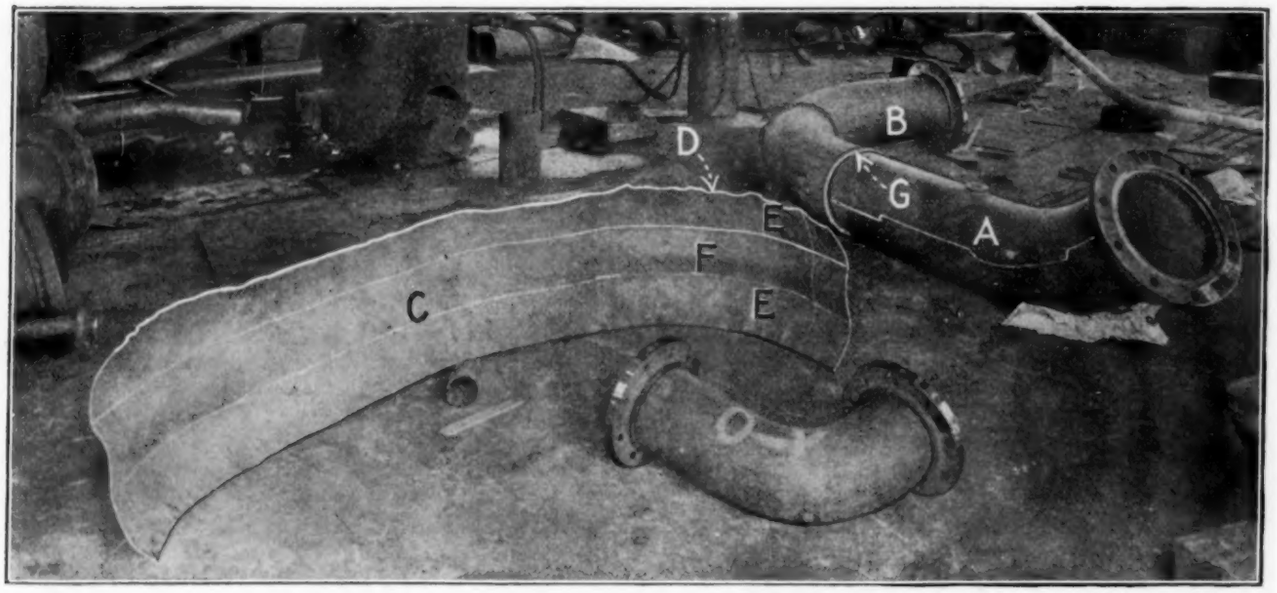


FIG. 4. DISCHARGE PIPE MADE IN FOUR PIECES

my faces *F* are erected and secured in exactly the same relation to each other as those of the low-pressure cylinder and the condenser on the ship. The openings *G* in *F* are a little larger than the size of the pipe *A*.

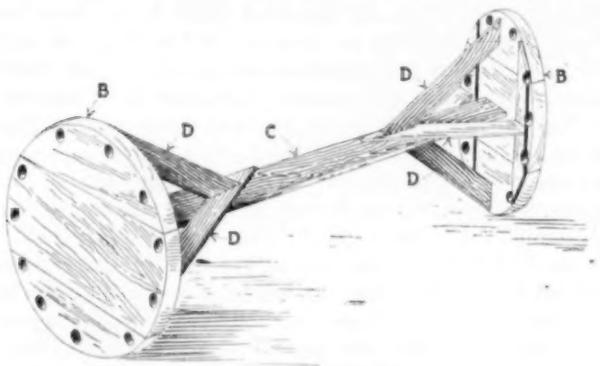


FIG. 3. THE TEMPLET

The bolt holes in *B* are laid off in correct position on the faces *F* and bored. The two flanges *H* are now bolted to the inner faces of *F* and the setup is ready for the coppersmith. His work consists in bending the large pipe *A* to correct shape, passing it through the openings *G* and the affixed flanges *H*.

It will be noticed that there is a groove around the inner edge of the flange *H* next to the pipe. When the pipe has been correctly bent, each end is cut off to length, flanged and peened over into this groove. The depth of the groove is slightly less than the thickness of the copper used in the pipe, so that when it is solidly peened in there is enough metal to finish the face.

Formerly it was thought necessary to braze all flanges in place. This is still done with many of the smaller sizes of pipes, but providing the peening has been properly done it is not necessary when steel flanges such as *H* are used.

Two men work on a job like this main-exhaust pipe and it takes about 380 hours to complete it. The thickness of copper is No. 2 B. W. G. The greatest pressure to which it is subjected is not more than 10 to 15 pounds.

The pipe shown at *AB* in Fig. 4 is in two lengths, which are each made of two pieces. One of the half

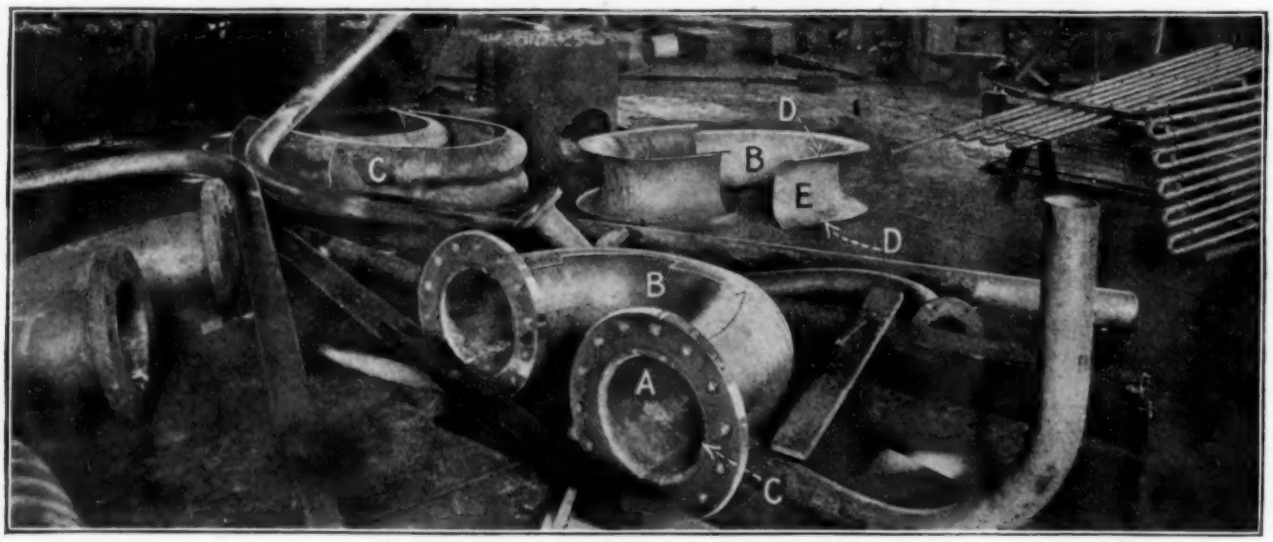


FIG. 5. AN ABRUPT BEND AND ITS COMPONENTS

pieces for the *B* section is shown at *C*. A pipe like this is not difficult to produce, but in Fig. 5 at *A* is shown a bend which requires a skilled coppersmith to produce. Such a pipe is made from two pieces of flat copper sheet, the joint running roughly as indicated by the dotted line on *A*. Obviously when making the inner half *B* from flat stock the edges *D* must be stretched and is therefore thinner than the center *E*, as the original sheet is flat, of uniform thickness and of equal length throughout its width, while edges *D* are longer than the end-to-end distance measured through the center line *E*. The reverse is true of the outer half *C*. In these sections the edges are shorter than the end-to-end measurement on the center line. This means that the edges must be shortened and therefore thickened.

The piece *C*, Fig. 4, will serve to show the way the copper is "humored" into shape.

The flat stock is first cut to length and width, after which the width is divided into thirds, as shown by the white lines on *C*. The plate is then roughly bent in the flat to the approximate shape of the half pipe. It is next crimped along the edges as shown at *D*. The work is as far as possible done hot, as the copper is then more malleable. Judicious hammering with wooden mallets thickens up the edge *D*, and shortens it. The depressions at *E* are also driven outwardly with round-faced mallets. The stretching of the metal here facilitates the thickening of the metal at the edges. As previously stated bent iron rods are used as templets. In this case the rod would be bent to conform to the center line of the bent pipe. When the edges *D* have been formed into the shape of the templet the inwardly projecting ridge *F* is beaten out with mallets till the half pipe is to the correct circle. This end is of course not attained by merely pounding with mallets on the center of the inside of the half pipe. The hammering must be intelligently done and the metal at this point uniformly stretched; the edges must also from time to time receive attention, otherwise the work is apt to be distorted. When cutting the sheet to width allowance is made for the amount the two halves lap each other at the brazed joint. In the case of the pipe shown in Fig. 4, at *A*, allowance is also made in the length for the amount the one pipe enters the other at the joint *G*. The metal on the edges of the joints is thinned down, so the exterior of the pipe will be round. Brazing is done in a coke fire with borax as a flux and yellow brass as hard solder. One of the coppersmiths tells me that boric acid does not give good results in copper brazing.

After brazing, the pipes are pickled to remove the borax and generally to clean them, the joints appearing as in the two pipes shown in Fig. 6.

During fabrication pipes are apt to become dented. Dents are removed by hammering over a ball such as shown at *A*, Fig. 7. The curved pipe in Fig. 7 shown in place over the ball is similar to the pipe shown in Fig. 5. After the dents are removed the flanges are fitted. Copper pipes that are exposed to view in the engine room or elsewhere are planished on the ball. This makes the surface denser and after planishing the copper will take a high polish.

FIG. 6. SUCTION PIPE AFTER BRAZING

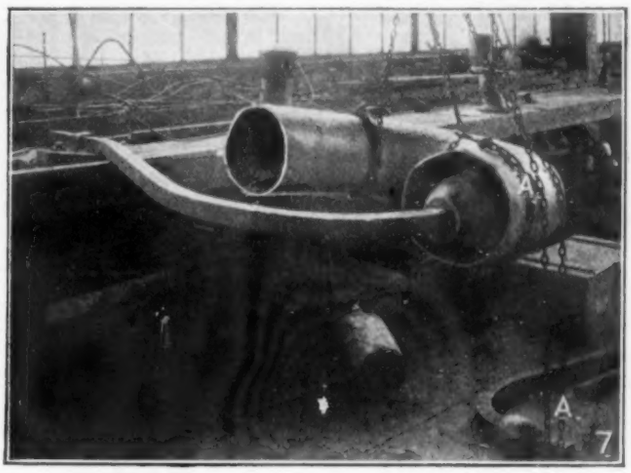


FIG. 7. HAMMERING OUT THE DENTS

Surplus Ordnance Scrap

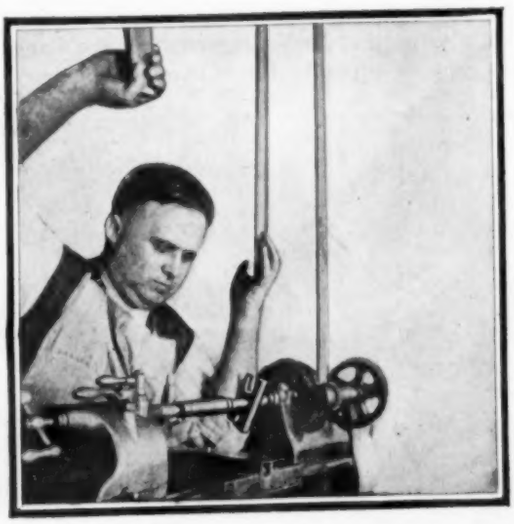
The Ordnance Department will order to be sold or stored, as conditions require, all surplus unused or obsolete construction and manufacturing material, both semifinished and completed parts. This includes miscellaneous supplies, etc., left over at the time of the cancellation or termination of ordnance contracts or any surplus at arsenals and supply depots. This will be handled by a subcommittee on the sale of material of the Salvage Board. The actual sale of this material will be handled by the Materials Branch of the Stores and Scrap Section of the Ordnance Department through the district stores and scrap managers located in each district office.

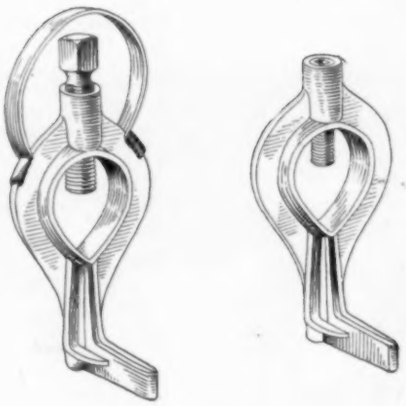
Lists of this material are now being prepared by Capt. Ralph B. Shaw, room 303, section 1 of B Building, Ordnance Department, Seventh and B Sts., Washington. These lists will be completed as promptly as possible after the materials are reported for sale. Any Government agencies or others interested in the purchase of any materials having been ordered sold or to be ordered sold by the Salvage Board should communicate with the Materials Branch.

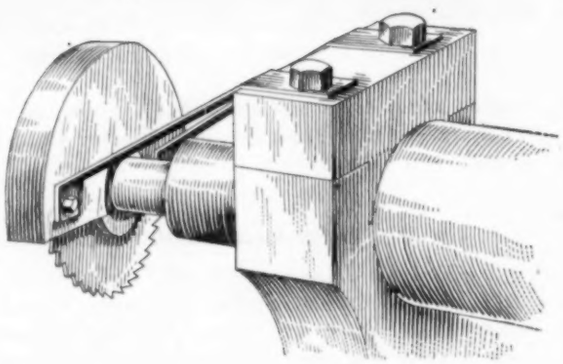
All scraps left over from the operations of ordnance contracts will also be sold. This scrap consists of different kinds of steel in sheets, billets and turnings, scrap-steel parts, cupronickel scrap, antimonial lead dross, silk and cotton waste, burlap, spent acid, etc.

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas







Why Do Ball Bearings Sometimes Fail?

By F. J. JAROSCH

Nothwithstanding the justifiable claims of ball-bearing manufacturers for their product these devices sometimes cause trouble to their users. Seldom, however, are these remissions due to the bearings, but to extraneous conditions, beginning with the improper selection of the types and sizes wanted up to plain mistreatment. The influence of these parts on the life of a machine is so great and the troubles arising from defect so numerous that they demand more than the perfunctory care generally given them, and for this reason this contribution should be of value to all tool builders.

BALL-BEARING manufacturers claim that annular ball bearings as recommended and used for passenger cars, trucks, tractors, airplanes, electric motors and generators, machine tools, line shafting and for all other kind of machines where efficiency is one of the first requirements are a finished piece of work; that their final development has been based upon sound theories and years of practical experience; that they are made of the best material available; that all dimensions are finished to the closest manufacturing tolerances; that all parts have to undergo a number of inspections and must be satisfactory in every respect, and that they are assembled with great care and precision. All this has been proved to be true, but in spite of all these claims ball bearings sometimes fail of expectations, and then the ball-bearing user, not taking the trouble to investigate the cause of the failure, condemns the bearing.

Of course there are cases where the bearing might have been faulty, but in my experience in investigating ball-bearing troubles I seldom found such cases, most of them being caused by the wrong selection of bearing types and sizes, incorrect mounting, improper lubrication and careless treatment. As no mechanic will permit his measuring instruments or other tools to be put to rough use, so also the bearing manufacturer tries to protect his product by issuing instructions, and only when these rules are observed can success be obtained.

Ball Bearings Precision Products

High-class ball bearings are made of the best grades of chrome-alloy steel, heat-treated and hardened. All surfaces are ground, the raceways and balls are highly polished, all dimensions are kept within limits of a few ten-thousandths of an inch, and the balls in each bearing are guaranteed to be spherical and of equal size within one ten-thousandth of an inch. As all these features are not fanciful ideas of the manufacturer, but are necessary, the ball-bearing user will understand that such bearings must be treated like any other precision product.

In selecting ball bearings for a particular purpose it is necessary to determine the maximum load and maximum speed under which they will operate, in what direction the load will be applied on the bearings, if this direction changes, and if vibrations, shocks, sudden changes of load or speed, excessive high or low temperatures and other possible troublemakers are liable to influence the proper operation of the bearings. The direction of the load will help to select the type of bearing, while all other factors, as the amount of load, speed, etc., which influence the carrying capacity, will be needed in selecting the correct size of bearing.

For radial loads—that is a pressure in a direction at right angles to the axis of rotation and where axial-directed load or end thrust is a negligible factor—a single-row annular radial bearing such as that shown in Fig. 1, or a double-row bearing of the same type is recommended.

Another design of annular radial bearing is shown in Fig. 2, where all pressures due to the load are applied through the lines *AA* and *A1 A1*, which meet and pass through the center of the bearing, which point is also the center of the spherical outer race. This type of bearing is capable of automatically adjusting itself to any deflection of the shaft on which it is mounted. For combined radial and axial loads another type of bearing has been developed, Fig. 3, where the load line is in such a position as to form the resultant of both the radial and axial load. To increase the radial carrying capacity and to take up axial loads in either direction a combination of two bearings of the latter type made up into a unit forms the double-row bearing, Fig. 4. A narrow type of bearing of different design of the raceways, but also developed for the purpose of taking up radial loads as well as axial loads in either direction, is shown in Fig. 5.

Axial or Thrust Bearings

For purely axial loads, that is, a pressure in a direction parallel to the axis of rotation, thrust ball bearings of the plain type, Fig. 6, or of the self-aligning type, Fig. 7, are recommended, but these types of bearings are for axial load only and should not be subjected to much radial load. In case axial loads change from one to the opposite direction, for instance in worm-gear drives, a number of different types of double-acting ball thrust bearings are illustrated in the catalogs of the bearing manufacturers. All these types are made in three standard series for light, medium and heavy duty, and the dimensions and carrying capacities will be found in the catalogs. The published carrying capacities of all bearings referred to are usually recommended for steady loads and speeds only, and a safety factor must be considered where detrimental factors might influence their carrying capacity. Whatever the case might be it is always safest to request the manuturer to select the proper type and size of bearing guaranteed to do the work.

The mounting of ball bearings is an important matter not only in the proper operation and life of the bearing itself, but also for the other parts on the same shaft, which will be affected by an incorrect installation of the bearings. Notwithstanding bearing manufacturers are always ready to recommend and describe the mounting of the bearings in detail, such information usually never reaches the man who mounts the bearings, and mistakes

are made which later cause the bearing to fail. If ball-bearing users would hand over to the men in the assembling shop not only the blueprints showing the general bearing layout but give detailed instructions on how to mount the bearings, and observe carefully how often ball bearings are mistreated bearing failures would soon disappear.

One of the first rules in mounting annular ball bearings is to mount the inner race a tight fit on the shaft and to fit the outer race with a snug sliding fit in the housing. As in most cases the inner race is rotating, while the outer race is stationary, the tight fit of the inner race will prevent it from working itself loose, while the stationary outer race will have a chance to creep slowly and bring all parts of it under the influence of the load.

There are press fits, drive fits, push fits, sliding fits and some other such expressions in use, and one might get confused in following such recommendations. A real press fit will rarely be employed for mounting the inner race, as this might expand the hardened bearing ring more than the material can stand, and render it liable to crack when put under load. Moreover such an expansion of the inner race will likely cause an elastic deformation of the balls and might also expand the outer race. This pressure, in addition to the working load, will often cause an overload on the bearing which will result in noisy operation and short life.

Taking into consideration that annular ball bearings are ground in bore to tolerances of 0.0002 in. plus to 0.0004 in. minus and 0.0006 in. minus for large bearings the table gives some limits for grinding the bearing seat on the shaft which will secure a tight enough fit for most ball-bearing mountings:

OVERSIZE GRINDING LIMITS FOR BEARING SEATS

Inner Race Diameter in Mm.	Bearing Numbers			Addition to Shaft Diameter in Inches	
				Min.	Max.
10 to 20	200 to 204	300 to 304	403 to 404	0	0.0003
22 to 40	205 to 208	305 to 308	405 to 408	0	0.0004
45 to 75	209 to 215	309 to 315	409 to 415	0	0.0006
80 to 110	216 to 222	316 to 322	415 to 420	0	0.0008

To facilitate the mounting of the inner race the bearing should be dipped into oil heated to about 110 deg. F., thus temporarily expanding the inner race. When driving the bearing on the shaft care should be taken not to strike hammer blows against the outer race, as such blows are transmitted to the balls and may produce flat spots on them, and, still more important, the retainer should not be struck as this will damage the bearing. The best way to drive the inner race on the shaft is to slip a tube, Fig. 8, over the shaft, lay a piece of wood across the free end and strike light hammer blows on the wood, producing an all-around equal pressure against the inner race. If the location of the bearing does not permit the use of such a tube it will pay to make a special tool of such shape as required by the space available. Such tools should be made of soft steel, bronze, brass, etc., but never use hardened steel or strike with the hammer direct on the bearing rings, as such blows always produce a one-sided pressure, and even the best mechanic in the shop is not clever enough to hit always the exact spot he aims at.

The bearing seat on the shaft must be cylindrical, and should be ground and inspected to make sure that it is not oval or tapered. Taking into consideration the high carrying capacity of ball bearings and the small surface of the bearing seat on the shaft, the pressure per unit area on the shaft, produced by the loaded bearing, will be very high. Now if the inner race touches its seat only at a few points this pressure may become excessive, the hardened inner race may press itself into the soft material of the shaft, work itself loose and tear off the material of the shaft. A loose bearing will move edgewise and bring all parts mounted on the shaft out of alignment, besides setting up vibrations.

It often happens that a formation of rust between the bore of the inner race and the bearing seat makes it difficult to dismount the bearing after it has been in service. In order to prevent this rust the bore of the bearing and the seat on the shaft should be cleaned with gasoline to remove all finger marks and moisture, and then apply a coat of pure, filtered mineral oil previous to mounting the bearing. If the bearing seat on the shaft is turned only or rough-ground, finely pulverized graphite or graphite grease may be rubbed into the surface.

Proper Mounting Important

Referring to the mounting of the outer race the bore of the housing must be cylindrical and must not be oval or tapered. If tapered the outer race will not have sufficient seat and might be pressed out of shape by the action of the load, at the same time producing an overload on the balls in some sections of the bearing. Special attention should be paid to split housings, as sometimes the parts of such housings do not match up exactly to form a cylindrical seat for the bearing.

It also cannot be called good practice to mount bearings directly in soft-metal housings, such as aluminum or other soft compositions, for under the influence of vibrations the outer race will pound its seat and become loose in a short time. For such cases a steel sleeve should be forced into the soft-metal housing and the bearing mounted into this sleeve. Before slipping the bearing into place inspect carefully to see that the inside of the housing is clean and that there is no sand, filings or other foreign matter sticking in the corners, which later will get into the bearing and act as an abrasive between the balls and raceways.

In assembling gear boxes and other machine parts very often files, emery cloth and other abrasives are used for smoothing rough edges on the shaft, gears or housing parts, and the residue of this operation adheres to these parts and is left there. This foreign matter will later be carried by the lubricant into the bearings and will cause trouble in a short time. Ball bearings must be kept clean, and therefore they should not be taken out of the boxes until they are needed. Do not let them lie about on the work bench or near a vise. Once in the bearing dust will settle in the pockets of the ball retainer, which cannot be easily washed out. Keep in mind that the proper working of the gears and all parts on the shaft depends to a great extent upon the correct mounting and good service of the bearings.

If possible, the inner race should always be locked laterally against a shoulder sufficiently high to give it good support. The fillet at the shoulder on the shaft should be the same or smaller than the standardized chamfer or radius of the bearing ring. If the radius of the fillet is larger than the chamfer of the inner race

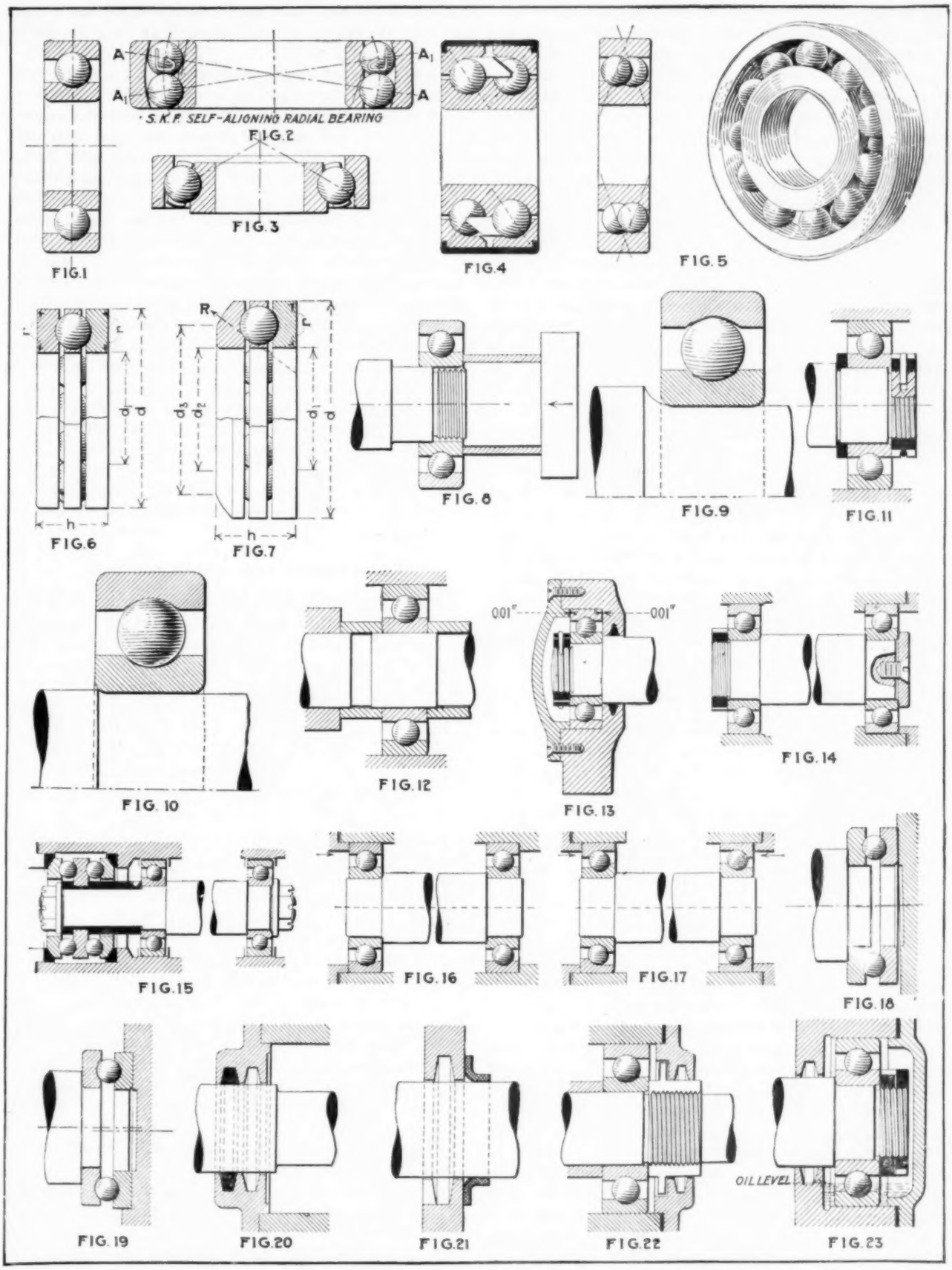


Fig. 1—Bearing for radial loads. **Fig. 2—Self-aligning radial bearing.** **Fig. 3—Bearing for** combined radial and axial loads. Fig. 4—Combined axial and radial bearing to take loads from either direction. Fig. 5—Bearing for same purpose, but of different design. Fig. 6—Thrust bearing for axial loads. Fig. 7—Self-aligning type. Fig. 8—Way to drive on a bearing. Fig. 9—Result of too large a radius. Fig. 10—Result of too low shoulder. Fig. 11—Suggested method of fitting. Fig. 12—Bearing locked between sleeves. Fig. 13—Indicating lateral play. Fig. 14—Two radial bearings on same shaft. Fig. 15—A case where one bearing should be laterally free. Fig. 16—An incorrect mounting. Fig. 17—Combined radial and thrust bearing. Fig. 18—Another mounting. Fig. 19—Washers held eccentric to each other. Fig. 20—Method of closing housing openings. Fig. 21—Application of a leather washer. Fig. 22—An overlapping housing. Fig. 23—The proper oil level

the latter will not rest against the shoulder, but will be wedged upon the fillet as shown in Fig. 9. If the shoulder is too low the inner race will slip over this shoulder as shown in Fig.10, and if the side pressure is excessive it will expand the bearing ring and possibly crack it. This can be prevented by turning a sharp corner at the fillet and by slipping a washer over the shaft, illustrated in Fig. 11, thus providing a sufficiently high shoulder for the inner race. Should it be impossible to provide such shoulders on the shaft itself the inner race should be locked between sleeves which might be made to rest against other parts on the same shaft as shown in Fig. 12. For annular radial bearings which are subject to axial loads, or are to fix the location of the shaft in lateral direction, the outer race will be mounted between shoulders in the housings, but it should not be clamped tight, like the inner race, but should be given on either side a lateral play of about 0.01 in. as shown in Fig. 13, so that it can creep and bring all parts of it under the influence of the load.

Where ball bearings are subject to the influence of high temperature, as for instance crankshaft bearings for gasoline engines, bearings must be assembled with a slight end shake; that is, the balls must have a slight radial and axial play in their grooves. As the soft material of the shaft and the housings will expand more than the dense, hardened steel of the ball bearings, the rings and balls must have sufficient space to meet especially the lateral expansion of the shaft, otherwise the immense pressure produced by this expansion will press the ball tightly between the races and cause an overload and noisy operation of the bearing.

Mounting Groups of Bearings

If two or more radial bearings are located on the same shaft, Fig. 14, and the housings are locally stationary, that is, cannot adjust themselves to the bearings, only one of the bearings should be locked laterally in both races, while of the other bearings, only one of the races —preferably the rotating one—should be locked sidewise. The other races must be laterally free, so that these bearings can automatically adjust themselves to the bearing locked in both races. As the bearing locally fixed in both races will prevent a lateral movement of the shaft and will have to take up all axial pressures it will be of advantage to lock that bearing which will receive the least amount of radial load compared to its carrying capacity. Where single or double acting thrust ball bearings are provided to take care of the axial loads one race of each radial bearing must be laterally free, Fig. 15, so that the entire axial load can be received by the thrust bearing.

An incorrect mounting often used for the countershaft in transmission gears is shown in Fig. 16, as here, when tightening the housing caps in the direction of the indicated arrow, the diagonal pressure upon the bearing will wedge the balls tightly between the races and quick wear will result. This method is recommended for ball bearings of the combined radial and thrust type, Fig. 17, as they are designed for taking axial as well as radial loads, and in this arrangement one bearing must counteract the other. There are instances where the outer race is rotating and the inner race is stationary, for example in wheel hubs, idler pulleys, etc., but in such cases it is not necessary to mount the outer race a tight fit; a good push fit will be sufficient, as likely it will be locked laterally.

In regard to thrust ball bearings the manufacturer does his part and carefully inspects the washers to make sure that the surface is parallel with the bottom of the groove and that the grooves are concentric with the bore and outside of the washers. Obviously he expects that the bearing users also do their part, mount the thrust washers between parallel shoulders and observe that the seat on the shaft and the recess in the housing are concentric. Fig. 18 shows a ball-bearing mounting where the stationary washer touches the housing only with a small part of its back surface; the bearing will rock and very likely will be overloaded at that point. In Fig. 19 the washers are held eccentric to each other, the balls will be pressed out of the grooves and will be twisted around, and if the shaft has some radial play it will be pressed out of alignment. In either case the bearing will wear quickly and will have a short life, thus producing more and more play which finally will influence all other parts mounted on the same shaft.

A number of locking devices are recommended and used for fastening the bearing races to the shaft and housing, but their construction largely rests on the available space.

Dust Protection and Lubrication

Bearing housings must be closed in order to protect the bearings against water, dust and other detrimental matter and also to hold the lubricant in place. This part of bearing mountings often does not receive the proper attention, although it is as important as other things. The construction of the bearing housing depends to some extent on the general construction of all other parts connected with it, but no matter what its shape there will always be some way of closing it. Housing openings provided for the passage of the shaft are usually closed by turning lips and one or more grooves in the housing lids, as shown in Fig. 20, and to leave a clearance of about 0.01 in. between these lips and the shaft. The old practice of pressing felt washers into these grooves will close the opening tightly enough, but when saturated with oil the felt becomes a dust catcher, the dust gradually working into the bearing housing. It is better to fill these grooves with a stiff grease or, if two grooves are provided, to leave the inside groove empty so that if any foreign matter gets thus far it can be deposited into this groove. In flour mills, farm tractors, etc., it will be advisable to slip a leather washer tightly over the shaft, Fig. 21, which, on account of its elasticity, will press itself against the housing lid. There are other good ways, like overlapping housing parts, Fig. 22, or pressed sheet-metal caps, and their construction and shape will depend on the space available for them.

Some investigators of ball-bearing theories claim that inasmuch as there is a true rolling motion of the balls in the grooves there can be no friction or wear, and consequently ball bearings do not need lubrication. This theory is based on the assumed fact that the balls have a point contact with their raceways; but in reality the conditions are somewhat different from the theory. A point is an imaginary thing, having no area, but as

loads cannot find support on imaginary things they must have areas to rest upon.

In a loaded bearing the load is pressing upon the balls, and as they are made of an elastic material they will undergo slight elastic deformation, whereby areas of contact are produced conforming to the curvature of the raceways. As these areas of contact are extremely small the pressure per unit area will be extremely high, and much care must be taken in selecting a lubricant that under such condition will prevent a metal-to-metal contact. The lubricant must have such viscosity as to form an unbroken film and at the same time must have enough body to adhere to the surface, and must not be squeezed out by the high pressure between the surfaces. The lubricant must not materially change its viscosity by a change in temperature caused by the weather conditions of summer and winter or by the climatic conditions of the North and South.

Suitable Lubricants Few in Number

There are a multitude of lubricants on the market, but only a few of them are suitable for ball-bearing lubrication. Lubricants used for transmission, bevel, differential and worm gear drives, cylinders and pistons in engines, and wherever a number of driving machine parts are assembled and inclosed in one casing also have to serve for the ball bearings mounted in the same casing. From the standpoint of the ball-bearing manufacturer such lubricants need watching, for while some oils or greases might in the opinion of shopmen and lubrication salesmen be good enough for the gears, they are liable to harm ball bearings.

It cannot be repeated too often that ball-bearing lubricants must not contain water, acids, alkali, free carbon, grit or other kinds of impurities which might effect the highly finished surfaces. Water will oxidize the steel and produce rust which will flake off and leave pits, thereby gradually destroying the smooth surfaces of ball and raceways. Rust flakes will mix with the lubricant and act as an abrasive, thus causing a quick wear of the bearing. Animal fats and oils, besides containing fatty acids, will become rancid, while vegetable oils will become gummy and dry up. Some mineral oils and greases contain acids or alkali either as a necessary component of their composition or as a part of some filler used to adulterate the oil or to alter its viscosity and sometimes as a residue of some of the processes of purifying when refining from the crude product. Free acids and alkali will cause an etching of the steel and, like rust, will also destroy the smooth surfaces of ball bearings.

The only kind of lubrication which will meet the requirements for ball bearing is a pure, filtered petroleum oil and petroleum jelly or vaseline, as they have the highest lubricating qualities and contain practically no impurities. The quality of these lubricants depends upon the quality of the crude oil and the thoroughness of refining and compounding, and the purchaser must depend upon the reputation of the manufacturer to some degree.

It is usually recommended to use a thin oil for high speeds and light loads, an oil of medium thickness for speeds from 500 to 2000 r.p.m., and grease of moderate thickness for low speeds and heavy loads. It will be sufficient to have the oil level reach to about the center of the lowest ball as shown in Fig. 23. Excessive lubrication in the bearing housing will not benefit the bearing, but will cause a rise in temperature produced by the resistance of the lubricant against the fast-rotating parts of the bearing and by the friction of the lubricant in itself. An all-around good lubricant for all bearings will be a slush made up of pure vaseline and a lighter mineral oil. When slightly heated this mixture will readily penetrate all parts of the bearing and after being cooled off it will stay there and will not run out like lighter oils. For high speeds provision must be made to hold the thin oil in the housing and for renewing it. Beware of lubricants mixed with ground mica, cork, wood, asbestos, and other such substances, which are used sometimes for eliminating the noises in worm gears, as this mixture will clog up the bearing, will wedge between raceways and balls, and will force the latter to slide. Cases are known where emery powder mixed with grease was used for running in new gears in already assembled transmissions. This mixture also got into the bearings, and as it was impossible to clean out bearings already mounted it caused wear and started trouble in a very short time.

The proper operation of gears and other running parts on a shaft depends principally on the bearings. In the automotive field—passenger cars, trucks, tractors, airplanes, motor boats, etc.—and in the use of high-class machines where efficiency plays an important part plain bearings have been replaced by ball bearings in order to save fuel and power by reducing the friction to a minimum, but this can be fully accomplished only if the ball bearings are mounted and treated in the right way.

It will be to the benefit of every ball-bearing user in any branch of industry to pay close attention to the instructions freely given out by the ball-bearing manufacturer as only then full success can be obtained. If there are any signs of trouble consult the ball-bearing man and do not wait until the damage is done.

The Next Move—Human Interest

By John R. Godfrey

It doesn't matter much what the game is the fellow who can keep three jumps ahead of the crowd has every advantage. But it takes a live wire to know when the next move is due.

Those who watch the signs and symptoms of the times are convinced that now is the right time to move, and incidentally to be sure and move in the right direction. They realize that peace parleys and the principle of self-determination of little nations also apply to industry right here at home as well as to Liberia or East Africa and other places which are such a long ways off. It means that the little fellow, whether the small manufacturer or the workman, has got to be guaranteed a square deal and not be shut out by any "balance of power" that may be worked against him.

We've been throwing away a lot of good material during these past four years—thousands of tons of steel and the coal it took to make it, thousands of tons of explosives, and nitrates which ought to have gone to fertilize our acres, and other things almost without number. And just as with the individual who has blown in his money without rhyme or reason, who has

spent many times more than he can earn in the same time, we must make more and spend less in the years to come. We must increase our production; we must waste less material and be more frugal in every way.

Greater production, and at a lower cost per unit of production, is the watchword of every good manager; more wheat per dollar, both for our own use and the use of the rest of the world, and other things to match. This, however, does not mean more system or less wages, at least at present. It means the increasing of production by newer and better methods.

Many who have studied the question carefully believe that much greater production may be secured by getting back some of the human interest in the work which our scientific-management friends have taken away from it. It means a getting back to really human relations instead of thinking of men as numbers and forgetting that they have feelings and aspirations like our own.

We have devoted so much time to putting in systems and purely mechanical devices for running our businesses that we have for the most part quite overlooked the most vital part of industry—the human element which is behind it all and without which there would be no industry and no need for it. We have in too many cases considered the man as part of the machine and so entirely devoid of human attributes that we have failed to get his coöperation, and in so doing we have also failed to get nearly as much out of our expensive machine equipment as we might have done.

We have made time studies and motion studies to try and save seconds when we might have saved minutes and hours by getting the coöperation of the men themselves. We have assumed that all the brains of the establishment were tied up in the craniums of a few men, some of whom knew almost nothing about our shops, or any shops for that matter, and have failed to avail ourselves of the intelligence which lay within our grasp in the brains of the workers themselves.

We have paid efficiency experts a hundred dollars a day to come into our plants and try to tell us what ailed them, when as a matter of fact many of them never had any practical experience in shops of any kind. And then we have grudgingly paid a foreman or a worker five dollars for an idea from the suggestion box which saved us dollars every day in the year. We have spent all kinds of money for cards and files and systems brought to us by outsiders and have confiscated without remuneration devices which grew in the brains of our own men on the plea that their weekly salary gave us a right to all that they might evolve. And then we have wondered why we did not get loyalty and devotion.

The next move is due now. It is time to prepare for those three jumps ahead of the crowd. Some have jumped already and are reaping their reward in the absence of labor turnover, in the reduction of costs and in the genuine loyalty and coöperation from every man in the plant. It is time to study men rather than methods; to study the reasons that the old shop could count on the coöperation of every man in the plant, to have the best that was in every man both as to brains and muscle. It is time to study ways and means of reviving the old family spirit, to make men feel that they really belong and are not mere appendages to a machine or mere numbers on the payroll. It can be done and it is being done in a number of shops. These shops are paying big dividends, not only in goodwill but in cash, and a goodly share of it is going to the men who have helped to produce it.

This is a new problem to many, but there are fortunately new physicians in the field to help us diagnose the cases and apply the proper remedies. Some of these men have been pioneers and have had wide and successful experience during the past few years. Fakers will also spring up, just as they did in the scientific-management field, and they will do even more harm than they did before, because this is a more serious problem. But the beginning in each case must come from within. There must be a genuine desire to improve conditions and the relations with the men.

It is time for the first jump. And it is well to be sure that it is in the right direction. Reaction, the attempt to reëstablish the old prewar conditions, is a step backward and can only bring disaster. Prewar conditions will never return. The new era will be different, and it is up to us to make it better. Let us study men more closely and we shall find it pleasant and profitable.

Preservation of Productive Equipment Used During the War

By Luther D. Burlingame

Two reasons why the vast equipment provided for producing war material should be preserved by the Government are: First, as a matter of preparedness and as a guarantee for future peace; and second, that the market may not be flooded with second-hand machines and tools that will demoralize industry.

If this equipment is scrapped or turned over to the second-hand market it will bring the Government but a fraction of its original cost, and the time might come when its having been preserved under Government control would be of incalculable value in preserving peace or in meeting the aggressions of an enemy.

While applying particularly to special machines and equipment, the utilization of which in the industries of peace would tend to lower the standard of efficiency because ill adapted to their needs, it also applies to standard machinery and tools, the supply of which during the war was shown to be so inadequate. While it is not suggested that factories should be maintained with machines belted up ready for war work it is believed that adequate storehouses already in existence should be retained with a complete equipment of tools, gages and machines kept in them which would be available at short notice.

If it be urged that such equipment would soon become obsolete, it might be answered that with the coming of a world league to enforce peace the stimulus for producing new and more destructive agents of war will be largely removed, and therefore the existing munitions will be sufficient for any eventualities.

Such a policy would pay for itself many times over not only in the matter of preparedness but also in avoiding the loading of manufacture with equipment that would be a handicap in world trade and that would tend to glut the machinery market during the transition period when business stagnation or collapse would be disastrous.

Inspection of Metallic Electrode Arc Welds

By O. S. ESCHOLZ
Research Engineer Westinghouse Electric and Manufacturing Co.

The inspection of welds is very important, and unless properly done serious trouble may occur. This article outlines the best methods for satisfactory inspection tests.

DETERMINING the character of welded joints is of prime importance, and the lack of a satisfactory method, more than any other factor, has been responsible for the hesitancy among engineers of the extensive adoption of arc welding. To overcome this prejudice it is desirable to shape our rapidly accumulating knowledge of operation into an acceptable method of inspection.

Manufactured apparatus is practically all accepted on the basis of complying with a process specification

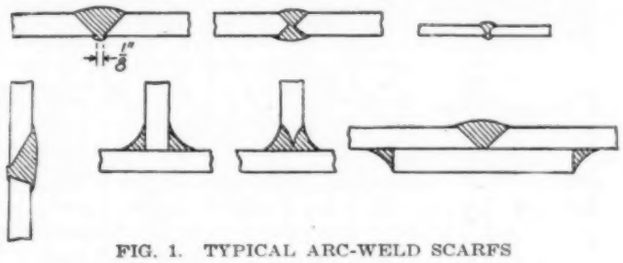


FIG. 1. TYPICAL ARC-WELD SCARFS

rigidly enforced in conjunction with the successful reaction to certain tests applied to the finished product. Riveting impairs the strength of the joined plates, yet with a proper layout and intelligent inspection the completed structure possesses certain definite characteristics which do not require further verification. The inspector of a finished concrete structure is practically helpless, and the weakest sort of construction may be concealed by a sound surface. With careful supervision, however, the physical properties of the completed structure can be reliably gaged to the extent that the use of concrete is justified even in ship construction. With this in view, electric arc welding is susceptible to even better control than obtain in either of these structural operations.

The four factors which determine the physical characteristics of the metallic electrode arc welds are: Fusion, slag content, porosity and crystal structure.

Some of the other important methods that have been suggested and used for indicating these characteristics are:

1. Examination of the weld by visual means to determine (a) finish of the surface as an index to workmanship; (b) length of deposits, which indicates the frequency of breaking arc, and therefore the ability to control the arc; (c) uniformity of the deposits, as an indication of the faithfulness with which the filler metal is placed in position; (d) fusion of deposited metal to bottom of weld scrap as shown by appearance of under side of welded joint; (e) predominance of surface porosity and slag.

2. The edges of the deposited layers chipped with a cold chisel or calking tool to determine the relative adhesion of deposit.

3. Penetration tests to indicate the linked unfused zones, slag pockets and porosity by (a) X-ray penetration; (b) rate of gas penetration; (c) rate of liquid penetration.

4. Electrical tests (as a result of incomplete fusion, slag inclusions and porosity) showing variations in (a) electrical conductivity; (b) magnetic induction.

These tests if used to the best advantage would involve their application to each layer of deposited metal as well as to the finished weld. This, except in unusual instances, would not be required by commercial practice in which a prescribing welding process is carried out.

Of the above methods the visual examination is of more importance than generally admitted. Together with it the chipping and calking tests are particularly useful, the latter test serving to indicate gross neglect by the operator of the cardinal welding principles, due to the fact that only a very poor joint will respond to the tests.

The most reliable indication of the soundness of the weld is offered by the penetration tests. Obviously the presence of unfused oxide surfaces, slag deposits and blowholes will offer a varying degree of penetration. Excellent results in the testing of small samples are made possible by the use of the X-ray. However, due to the nature of the apparatus, the amount of time required and the difficulty of manipulating and interpreting results, it can hardly be considered at the present

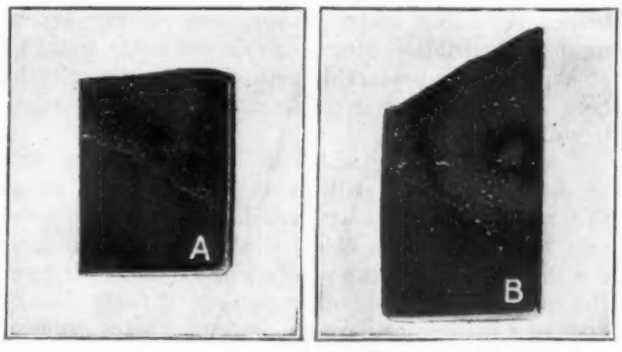


FIG. 2. GOOD AND BAD WELDS

time as a successful means to be used on large-scale production.

The rate that hydrogen or air leaks through a joint from pressure above atmospheric to atmospheric, or from atmospheric to partial vacuum, can readily be determined by equipment that would be quite cumbersome, and the slight advantage over liquid penetration in time reduction is not of sufficient importance to warrant consideration for most welds.

Of the various liquids that may be applied kerosene has marked advantages because of its availability, low volatility and high surface tension. Due to the latter characteristics kerosene sprayed on a weld surface is rapidly drawn into any capillaries produced by incom-

plete fusion between deposited metal and weld scarf, or between succeeding deposits, slag inclusions, gas pockets, etc., penetrating through the weld and showing the existence of an unsatisfactory structure by a stain on the emerging side. A bright-red stain can be produced by dissolving suitable oil-soluble dyes in the kerosene. By this means the presence of faults have been found that could not be detected with hydraulic pressure or other methods.

By the kerosene penetration a sequence of imperfect structure linked through the weld, which presents the greatest hazard in welded joints, could be immediately located, but it should be borne in mind that this

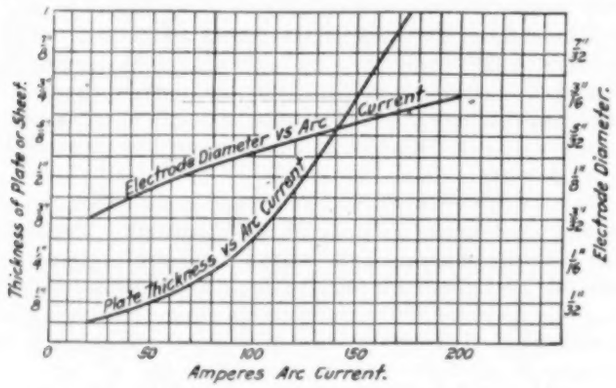


FIG. 3. DIAMETERS FOR WELDING STEEL PLATE

method is not applicable to the detection of isolated slag or gas pockets nor small, disconnected unfused areas. It has been shown by various tests, however, that a weld may contain a considerable amount of distributed small imperfections, without affecting to a great extent its characteristics.

If a bad fault is betrayed by the kerosene test it is advisable to burn out the metal with a carbon arc before rewelding under proper supervision. By the means of sandblast, steam or gasoline large quantities of kerosene are preferably removed. No difficulty has been encountered on welding over a thin film of the liquid.

Electrical tests, by which the homogeneity of welds is determined, are still in the evolutionary stages, and many difficulties are yet to be overcome before this test becomes feasible. Some of these difficulties are the elimination of the effect of contact differences, the influence of neighboring paths and fields, and the lack of practicable, portable instruments of sufficient sensibility for the detection of slight variations in conductivity or magnetic field intensity. No simple tests are plausible, excepting those which involve subjecting the metal to excessive stresses for determining the crystal structure. Control of this phase must be determined by the experience obtained from following a prescribed process.

The inspector of metallic arc electrode welds may consider that through the proper use of visual, chipping and penetrating tests a more definite appraisal of the finished joint may be obtained than by either riveting or concrete construction. The operation may be still further safeguarded by requiring rigid adherence to a specified process.

Good results are assured if correct procedure is followed.

Haphazard welding can no sooner produce an acceptable product than hit-or-miss weaving will make a marketable cloth. It is only logical that all the steps in a manufacturing operation should be regulated to obtain the best results. As it is most welders consider themselves pioneers in an unknown art that requires the exercise of a peculiar temperament for its successful evolution, and as a result welding operators enshroud themselves in the halo of an expert and do their work with a mystery bewildering to the untutored. Once in a while, due we might say to coincidences, these "experts" obtain a good weld, but more often the good weld may be attributed to the friction between slightly fused, plastered deposits.

In common with all other operations metallic electrode arc welding is really susceptible to analysis. Regardless of the metal welded with the arc the cardinal steps are: (1) Preparation of weld; (2) electrode

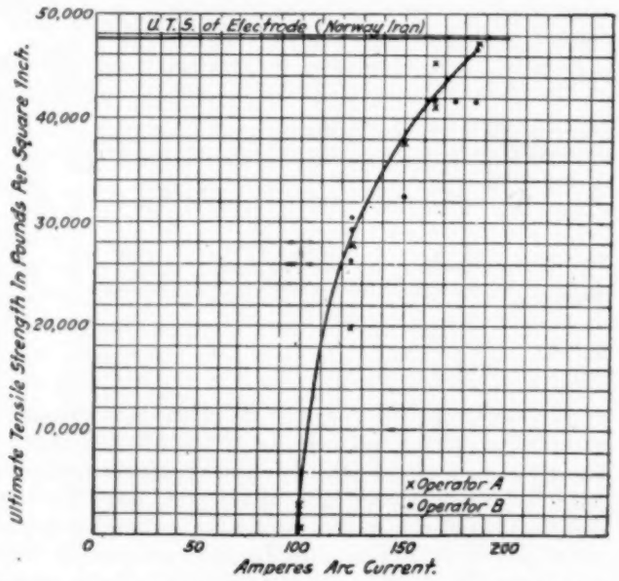


FIG. 4. VARIATION IN WELD STRENGTH WITH CHANGE IN ARC CURRENT

selection; (3) arc-current adjustment; (4) arc-length maintenance, and (5) heat treatment.

Sufficient scarfing is involved in the preparation of the weld, as well as the separation of the weld slants, so that the entire surface is accessible to the operator with a minimum amount of filling required. When necessary to avoid distortion and internal stresses, owing to unequal expansion and contraction strains, the metal is preheated or placed so as to permit the necessary movement to occur. Various types of scarfs in common use are shown in Fig. 1.

The electrode selection is determined by the mass, thickness and constitution of the material to be welded. An electrode free from impurities and containing about 17 per cent. carbon and 5 per cent. manganese has been found generally satisfactory for welding low and high carbon as well as alloy steels. This electrode can also be used for cast-iron and malleable-iron welding, although more dependable results, having a higher degree of consistency and permitting machining of welded sections, can be obtained by brazing, using a copper-aluminum-iron-alloy electrode and some simple flux. Successful results are obtained by brazing copper and

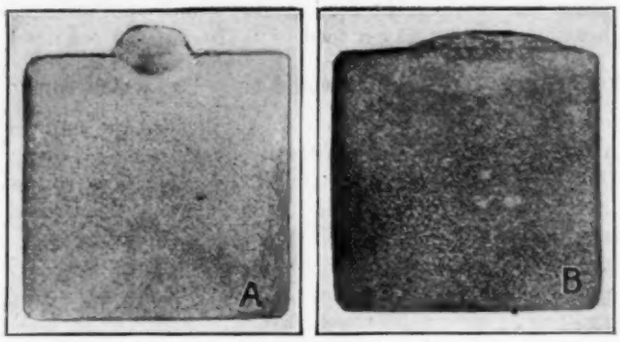


FIG. 5. SECTIONAL VIEWS OF SHORT AND LONG ARC DEPOSITS

brass with this electrode. The diameter of the electrode should be chosen with reference to the arc current used.

A great many concerns have attempted welding with too low an arc current and the result has been a poorly fused deposit. This is due largely to the overheating characteristics of most electrode holders, or using current value, and thus leading the operator to conclude that the current used is in excess of the amount that is needed.

A, Fig. 2, shows a section through one-half of an exposed joint welded with the proper current, and *B* the effects of too low a current. The homogeneity and the good fusion of the one may be contrasted with the porosity and poor fusion of the latter. These surfaces have been etched to show the character of the metal and the welded zone.

The approximate values of arc current to be used for a given thickness of mild-steel plate, as well as the electrode diameter for a given arc current, may be taken from the curve in Fig. 3. The variation in the strength of 1-in. square welded joints as the welding current is increased is shown in Fig. 4.

Notwithstanding that the electrode development is still in its infancy the electrodes available are giving satisfactory results, but considerable strides can yet be made in the ductility of welds, consistency in results and ease of utilizing the process.

The maintenance of a short arc length is imperative. A nonporous, compact, homogeneous, fused deposit on a 1-in. square bar from a short arc is shown in Fig. 5, *A*, and in *B* is shown a porous, diffused deposit from a long arc. Top views of these welds are shown in Fig. 6. A short arc is usually maintained by a skillful operator, as the work is thereby expedited, less electrode material wasted and a better weld obtained because of improved fusion, decreased slag content and porosity. On observing the arc current and arc voltage by meter deflection or from the trace of recording instruments, the inspector has a continuous record of the most important factors which affect weld strength, ductility, fusion, porosity, etc. The use of a fixed series resistance and an automatic time-lag reset switch across the arc to definitely fix both the arc current and the arc voltage places these important factors entirely beyond the control of the welder and under the direction of the more competent supervisor.

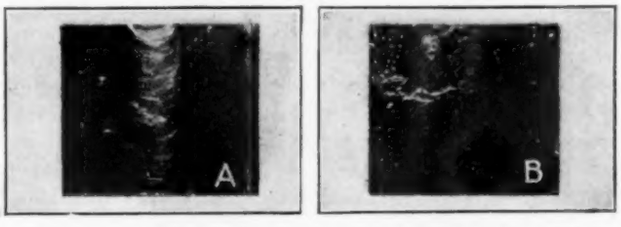


FIG. 6. TOP VIEWS OF WELDS SHOWN IN FIG. 5

Heat Treatment and Inspection

The method of placing the deposited layers plays an important part on the internal strains and distortion obtained on contraction. It is possible that part of these strains could be relieved by preheating and annealing as well as by the allowance made in preparation for the movement of the metal.

The heat treatment of a completed weld is not a necessity, particularly if it has been preheated for preparation and then subjected to partial annealing. A uniform annealing of the structure is desirable, even in the welding of the small sections of alloy and high-carbon steels, if it is to be machined or subjected to heavy vibratory stresses.

The inspector, in addition to applying the above tests to the completed joint and effectively supervising the process, can readily assure himself of the competency of any operator by the submission of sample welds to ductility and tensile tests or by simply observing the surface exposed on cutting through the fused zone, grinding its face and etching with a solution of 1 part concentrated nitric acid in 10 parts water.

It is confidently assumed, in view of the many resources at the disposal of the welding inspector, that this method of obtaining joints will rapidly attain successful recognition as a dependable operation to be used in structural engineering.

Calculations for Roll Feeds

By S. B. Royal

A method of making roll-feed calculations which may be of interest is here described. The way to obtain the number of teeth required in the ratchet, the number to feed and size to grind the roll to give an exact feed to within 0.001 in., which is often necessary on small work, is as follows:

Suppose we have a standard roll feed with 2½-in. hardened and ground rolls and are required to feed exactly 0.625 in. at each stroke of the punching machine $3.1416 \times 2\frac{1}{2}$ in. = 7.854 in. = circumference of rolls; 7.854 ÷ 0.625 in. (the amount to feed) = 12.56; therefore $\frac{1}{12.56}$ = the part of a revolution necessary to feed the metal 0.625 in. with a 2½-in. diameter roll.

But as a ratchet cannot be cut with 12.56 teeth, to find the proper number to cut we multiply the fraction $\frac{1}{12.56}$ by some number that will nearest remove the decimal part of the denominator and still not bring the total number of teeth too high. This will depend upon the diameter of ratchet the roll feed is equipped to take. In small roll feeds of this type this diameter is generally between 3 and 4 in. and 50 to 70 teeth is about the limit.

In this case we can use 2 as a multiplier $\left(\frac{1}{12.56} \times 2\right.$

$= \frac{2}{25.12}$), which will leave a smaller decimal part in the denominator than any other number that will keep the number of teeth within the maximum.

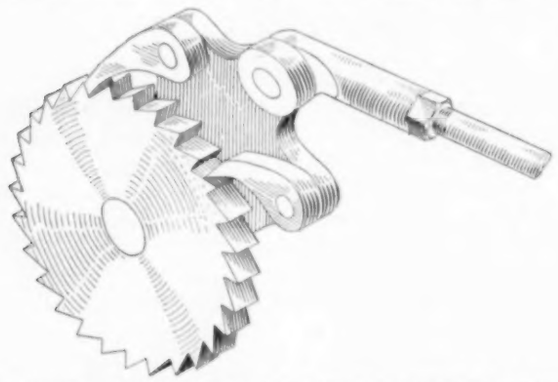
As the whole number of the denominator of the fraction is the number of teeth to cut in the ratchet and the numerator the number of teeth to feed at each stroke, we should cut 25 teeth in the ratchet and adjust the stroke of the lever so that the pawl will feed two teeth at each revolution.

It is evident that with a two-tooth feed on a 25-tooth ratchet the stock will be fed 0.628 in. or 0.003 too much, as $\frac{2}{25}$ of 7.854 (circumference of 2½-in. roll) = 0.628 in., or 0.003 too much. In many cases this 0.003 would be of no disadvantage, but there are cases where the feed must be within 0.001.

To accomplish this it is necessary to grind a small amount off the diameter of the rolls which can be calculated as follows:—$\frac{2}{25}$ of new circumference must equal 0.625 in., therefore 0.625 in. $\times \frac{25}{2}$ = circumference = 7.812 in. and 7.812 in. $\div$ 3.1416 = 2.4867 in. = diameter of rolls to feed 0.625 in.

Therefore 0.0133 in. should be ground off the diameter of the rolls, making them 2.4867 in. to obtain the exact feed required.

If the feed required had been 0.632 in. instead of 0.625 in. the fraction would be $\frac{1}{12.43}$ instead of $\frac{1}{12.56}$, and this multiplied by 2 would give $\frac{1}{12.43} \times 2 = \frac{2}{24.86}$, which would be all right if the feed did not have to be exact to the thousandth. A 25-tooth ratchet (the



RATCHET WITH PAWLS TO FEED ONE-HALF TOOTH

nearest number to 24.86) and feeding two teeth would give a feed of 0.628 in. If the feed were required to be exact the figuring would be slightly different from before, as we cannot very well add several thousandths to the diameter of the rolls. If we use a 24-tooth ratchet 0.086 in. would have to be ground off the diameter of the rolls, which is too much, as their gears would not mesh properly.

We would therefore multiply the fraction by 5 $\left(\frac{1}{12.43} \times 5 = \frac{5}{62.15}\right)$, meaning a 62-tooth ratchet and a feed of five teeth with the grinding of 0.0055 in. off the diameter of the rolls, making them 2.4945 inches.

Sometimes when the feed is very small another complication is met. Say a feed of 0.310 in. was required. In this case the fraction would be $\frac{1}{25.34}$, which cannot be multiplied by any number that will keep the number of teeth within the limit without considerable grinding. There are still two alternatives, first to increase the diameter of the ratchet and make the necessary new arm for carrying the pawl. If this causes interference or is not desired, two pawls can be used spaced a distance apart equal to any number of teeth plus one-half of a tooth, as shown in the diagram. In doing this the ratchet is figured for twice the number of teeth that are actually cut, and the number to feed is in half teeth as $\frac{1}{25.34} \times 3 = \frac{3}{76.02}$. Here the ratchet would have 38 teeth and 1½ would be fed at each revolution.

Three pawls can also be used if they are spaced one-third of a tooth apart; in this way any feed can be had to within 0.001.

We generally cut the teeth with a 60-deg. cutter with the straight side set in line with the center. It is always best to leave a small flat at the top of the tooth rather than a sharp point. This will to a certain extent regulate the depth to cut. As a rule $\frac{1}{16}$ in. to $\frac{3}{32}$ in. is sufficient for the depth of tooth and a ratchet with a small number of teeth may have flats of $\frac{3}{8}$ in. or more, but this is no disadvantage.

Hand Versus Power Feed in Surface Grinding

BY CHRISTIAN DAHLERUP

The lack of knowledge of the proper grain and grades of grinding wheels is not confined to toolmakers but is observed even in well-organized shops where production is an important factor and where it becomes a serious time-wasting proposition, as pointed out by Donald Baker on page 901, Vol. 49, of the *American Machinist*. This might also be said about any milling or shaping machine, etc., which is not operated at its proper speed and feed.

I presume the machine here discussed is one of the surface-grinding type generally used in toolrooms for all-round work and which is not so handy for gage-grinding and the lighter class of work.

I am in agreement with Mr. Baker that for such work nothing will give as satisfactory results as light cuts with coarse hand feeding, to which any toolmaker will soon get accustomed as well as to the "feel" of the wheel, which compares to the "feel" one should have on a sensitive drilling machine.

No doubt a small surface-grinding machine adaptable for light tool work and gage grinding, without power feed, would be an ideal and very handy tool for the toolroom, but so far as I know no such machine is on the market.

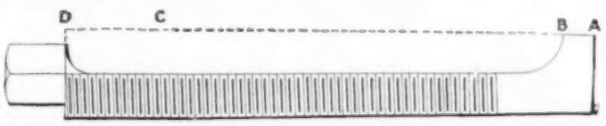
If it is not Mr. Baker's idea to recommend to the owners of surface-grinding machines to remove all power feeds from them, why does he not tell us where machines can be obtained that are not equipped with such feeds? I am certain many read of the *American Machinist* would appreciate this information.

Handy Tap for Long Holes

By Miles Smith

In the sketch I have given an idea of a tap which will be of advantage in tapping long holes either by hand or machine. The principal advantage is that the tap cannot clog with chips, and thus broken taps are rare.

The method of its making can best be explained by sticking to the details of the sketch. First turn up a



TAP FOR LONG HOLES

blank, making the diameter *A* the diameter of the tap drill. Carry this diameter to *B*, or from ¾ to 1 in., according to your own views of the necessary length of a pilot. Next turn the opposite end or from *C* to *D* to the outside diameter of the tap required, making the distance *C* to *D* from 2 to 2½ in., according to the length of hole to be tapped. Then turn the length *CB*, carrying the taper necessary to reduce from the diameter *C* to the diameter *B*, the length to be determined to suit the work in hand, being mindful that the longer the tap the easier the work will be done, especially if a machine is used. Next thread the entire length from *B*. Do not flute, but after the blank is threaded mill away half of the tap from *B* to *C;* machine whatever head is desired and harden. The greatest care should be taken to insure milling the blank exactly to the center line.

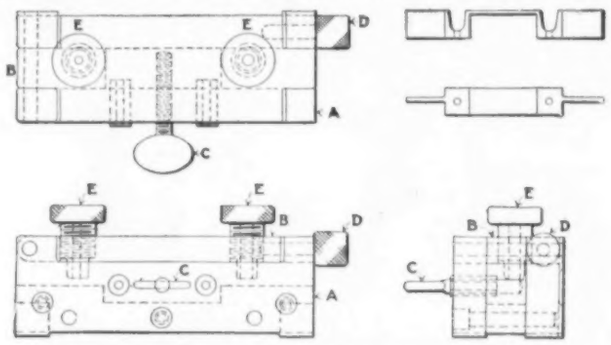
If these instructions are followed you will find a tool which will do its work easily and speedily with the most inexperienced operator.

A Built-Up Drill Jig for Small Castings

By M. H. Chase

We had several thousand small bronze castings, such as shown in the sketch, to drill, this being the only machining required, but the holes were required to be accurately spaced with relation to each other to make them interchangeable. The job had to be got out in a hurry, so we built up the jig from some machinery steel we had in stock instead of waiting for patterns and castings.

The jig consists of the built-up body *A* to which is fastened the hinged cover *B*. The casting is put in the jig and the thumbscrew *C* screwed up, clamping the web of the casting against the back wall inside the jig. The cover *B* is then closed and locked in place by means of the knurled-headed pin *D*. The threaded clamping bushings *E*, having the proper sized holes for drilling, are then screwed down clamping the pro-



A SIMPLE DRILL JIG

jecting feet against the nest of the jig, acting as drill bushings and clamps at the same time.

In the front of the jig are two plain bushings for drilling the 0.116 in. holes, which are drilled by turning the jig on its side. The cost, including material, is $24.

Punch and Die for Stamping Balls for Sheet Metal

By S. B. Royal

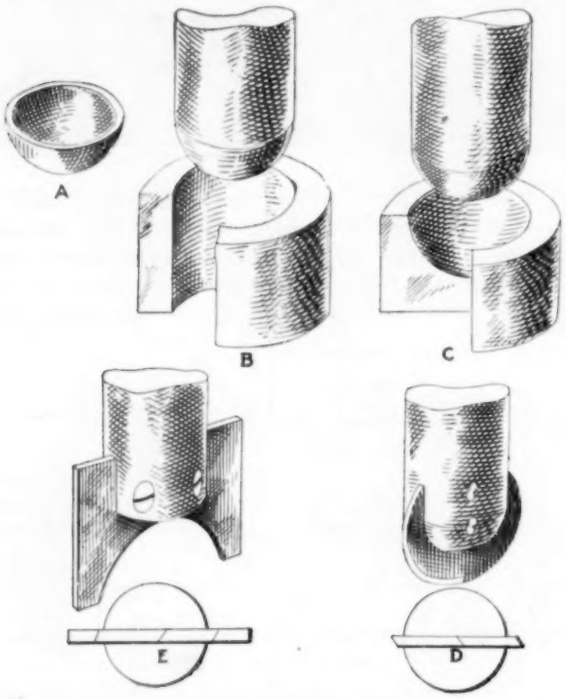
In drawing a half ball, as shown at *A* in the cut, of thin gold-plate stock the die must conform to the contour of the punch in order to iron out the stock and produce a surface capable of taking a fine finish. If a ball-shaped punch is used with a plain die, as shown at *B* the same shape will be produced, but the metal will have a rough, pitted surface. By using a punch and die as shown at *C* the metal will be ironed out smooth and will take a mirror-like polish.

Ordinarily to make a punch and die of this type requires a toolmaker of above average skill, as both punch and die must be perfect hemispheres and differ in radius by the thickness of the metal to be used. For this reason they cannot be fitted by the usual process.

A method which will enable anyone of ordinary skill to make them is here described. A bar of tool steel is turned to the exact radius of the die. A disk is then cut off this about $\frac{1}{16}$ in. thick and mounted in a holder as shown at *D*. The edges are beveled both ways, making an end mill which has a truly semicircular cutting edge. In beveling care must be taken not to file so far as to destroy the contour.

The mill for the punch is made, as shown at *E*, by boring a hole equal in radius to the required punch in a thin piece of steel, and after filing proper clearance on the edge mounting the piece in the holder.

These mills are accurate, are easily made, and will stand up for making several punches and dies. If a large quantity is required it is advisable to make a



TOOLS FOR STAMPING BALLS

master convex mill in the same manner for producing a number of working concave mills, and likewise a master concave mill to make the working convex mils.

[We are under the impression that tools made in this manner would not produce a "truly semicircular" contour unless the cutting edges were filed back so that both would lie on the center line. In this condition the cutter would be infinitely thin at the center and difficulty would be experienced in making this point conform to the desired contour.—EDITOR]

A Double Blanking and Drawing Die

BY G. R. SMITH

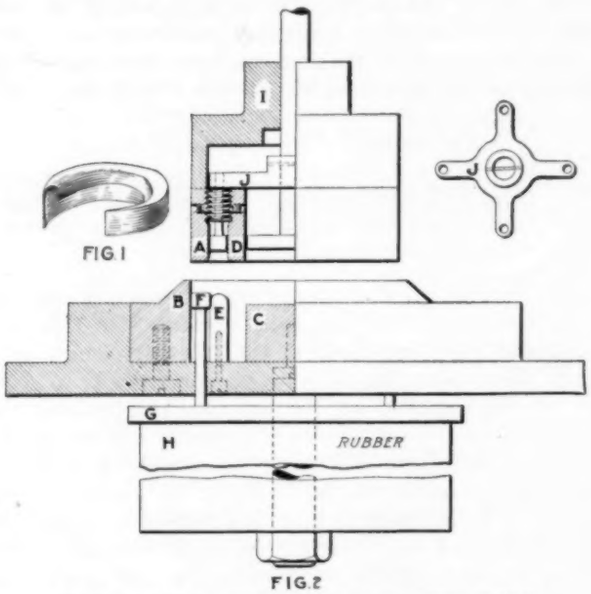
The press tools used in the manufacture of the cap shown in Fig. 1 may be of interest to the readers of the *American Machinist* inasmuch as it is rather an unusual and difficult form to produce in one operation. This shell was formerly made in two operations, but with the present tools it is made in one operation on a single-action press from strip stock in rolls, the production being about 2000 an hour. The tools are shown in Fig. 2.

The shell is blanked with the tool-steel ring *A* set in the punch and the tool-steel ring *B* in the die. After the blank is cut from the stock and held, slightly bent, in the die the center is cut out by the punch *C* and die ring *D*. The draw then takes place over ring *E*, the top of which is the same radius as the finished shell.

The pressure ring *F*, which also acts as a stripper, rides on four pins which pass down through the die block and rest on the machine-steel plate *G* on top of the rubber bumper *H*.

The pressure supplied by the bumper is regulated to suit conditions by a nut in the center bolt that holds the bumper in place. The punch *C* is held in position by fillister-head machine screws sunk in the die block.

The punch *I* is made of cast iron, with the tool-steel rings *A* and *D* screwed into position and held by blind setscrews. The radius on ring *A* draws the outside, and the radius on ring *D* the inside of the shell. The knockout shown at *J* is a steel spider having four arms, from the ends of which pins pass to the knockout ring. These pins are shouldered and screw into both the knockout ring and the end of the spider arms. The spider is pinned in position to the central knockout rod which carries at its bottom end a steel plate which serves to knockout the scrap cut from the center of the shell at the same time the shell itself is removed.



FIGS. 1 AND 2. THE WORK AND THE TOOLS

In shops where compressed air is available it may be used to separate these scrap centers from the finished shells. At the top end of the central knockout rod is a small nut which engages the knockout bar of the press, relieving the rod of wear.

These shells are made from 0.015-in. stock, both brass and steel. The press used is a single-action 2-in. stroke Bliss No. 21 straight drive, with back knockout.

A Two-Position Milling Fixture

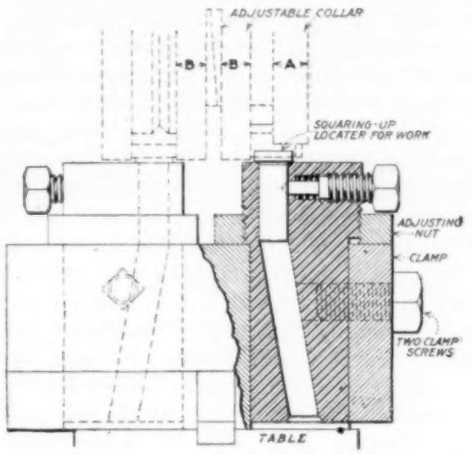
BY G. R. RICHARDS

According to the article entitled "A Two-Position Milling Fixture" on page 772, Vol. 49, of the *American Machinist* Mr. Fenaux would seem to be wasting a perfectly good milling machine, probably a 5-in. automatic, judging by the size of the work.

The table T-slot in this machine is $\frac{5}{8}$ in. wide and if the drawing is in proportion the head of the work being milled is about $\frac{7}{8}$ in. and the shank about $\frac{1}{2}$ in. in diameter. It is these approximate dimensions which make me think the smallest machine, a 5 in., is used.

If the fixture was designed as in the sketch here shown to hold two pieces it would be unnecessary to run the machine two complete cycles to complete one piece as one would be sufficient.

For the benefit of those who are unfamiliar with this machine it may be said that the table is operated and fed by a barrel cam which makes one complete revolution for each forward and return movement of the table, and,



IMPROVED TWO-POSITION MILLING FIXTURE

as Mr. Fenaux says, it is necessary to trip the starting lever twice for each piece, as the table, after completing the cut, returns to the starting point and stops automatically.

A fixture designed as shown would be also more rigid because closer to the table and because every movable and sliding part is clamped tight.

The adjustment for height on the right-hand side makes it unnecessary to grind cutter *A* to an exact diameter and would also prolong the life of the center side mills *B* used for squaring the head, as the single cutter shown by Mr. Fenaux does double duty and any reduction in width due to grinding makes it worthless.

Incidentally it would be interesting to know what the material is, as a 3-in.-per-minute feed is faster than is ordinarily taken.—[The suggestion in the foregoing letter is a good one inasmuch as by its provisions each machine would turn out nearly twice the amount of work as it would with the fixture described by Mr. Fenaux, but it apparently does away with the indexing feature of the former and is not therefore a just criticism of it.—EDITOR.]

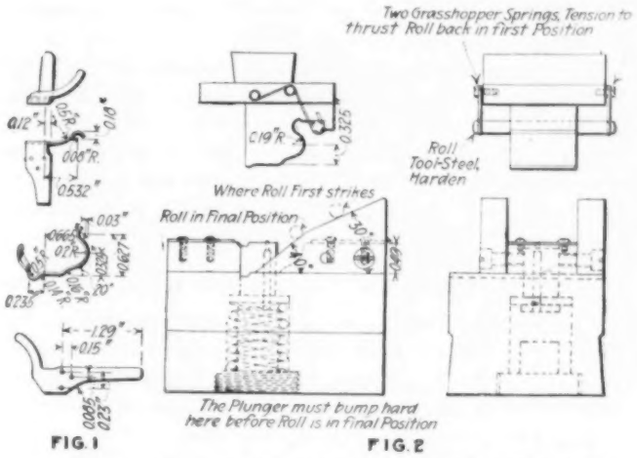
Die for Forming Small Blanks

BY JOHN TECKEER

A set of dies to form the piece shown in Fig. 1 was required to be used in the usual type of small jewelry-manufacturing press. Limited space prevented using the usual type of die with sliding plunger to form the upper bend, so a novel and original scheme shown in Fig. 2 was used effectively on the second bending die. This consisted of a roll attached with springs to the punch and operated by inclined planes attached to the die. In order that this roll should not be subject to too great stress the die was made to strike hard on the bottom at the time the roll reached its proper location, therefore the die bottom takes the shock of impact and the roll simply finishes looping in position the radius on the upper end of the blank.

On the second-operation die it will be noticed that one side is cut away tangent to the side of the plunger, thus the end already formed in the first operation is allowed to bend at right angles without interference.

The distance 0.325 in. from the center of the 0.19 in. radius to the bottom of the punch necessarily means that the corresponding distance on the die would be 0.365 as the stock is 0.04 in. thick. We then make the depth of the die 0.490, as shown, which leaves 0.125 in. above the center line and which is sufficient for a $\frac{1}{16}$-in. radius


Two Grasshopper Springs, Tension to thrust Roll back in first Position
Roll Tool-Steel, Harden
Where Roll First strikes
Roll in Final Position
The Plunger must bump hard here before Roll is in Final Position
FIG. 1
FIG. 2

FIGS. 1 AND 2. BLANK AND SECOND FORMING DIE

over which the metal must draw, and a $\frac{1}{16}$-in. straight. At this moment the roll, traveling down the inclined planes, picks up the end of the the blank and curls in the 0.100-in. radius, reaching its final position as the plunger bottoms hard on the surface below it.

The method used in laying out the die may be new to some. The punch is first carefully finished and the die laid out from it by using a scriber made of drill rod the diameter of which is twice the thickness of the blank. This is pointed central and rolled over the outline of the already finished punch.

Daily Time Card for Small Shops

BY V. C. BOWSER

I have used the style of daily time card shown in a small jobbing and repair shop. It has proved the most satisfactory of any I have used. With a minute's study it explains itself.

DAILY TIME CARD

Wm. Smith
EMPLOYEE'S NAME

DATE Oct 10-1918

NAME OR NO. OF JOB	START	STOP	START	STOP	START	STOP	TOTAL
Jones Truck Transmission	6 30	10 00	10 45	11 30	12 00	3 30	7.45
Williams Tire change	10 00	10 45					.45
Brown Valve Grinding	3 30	5 00					1.30
							10 00

TIME CARD FOR SMALL SHOPS

Editorials

Concerning Informal War Contracts

READERS of the *American Machinist* who are vitally concerned in the validation of informal war contracts will be interested in the statement of Joseph H. Defrees, chairman of the war-service executive committee of American industries.

Mr. Defrees' statement was called forth by the delay in Congress in getting the proposed legislation through, and more especially by the insertion by the Senate Military Affairs Committee of a provision giving the Government the right of appeal through the Department of Justice from the War Department's decisions respecting the contracts. Mr. Defrees' statement follows:

A Substitute for the Dent Bill

"The Senate Committee on Military Affairs has reported out as an amendment and substitute for the Dent Bill (H. R. 13,274), the War Industries Board bill, to which was added a section giving the right of appeal from the decisions of the War Department to both the contractor interested and to the Department of Justice to a commission to be composed of one representative of the War Department, one representative of the Department of Justice and one representative of the business interests of the country.

"There is also included in the substitute bill a section providing that in all instances where no affidavit is obtained from the officers of the War Department who had to do with the making of the contract stating that they were not interested directly or indirectly on the side of the contractor in respect to the contract such contracts cannot be settled by the Secretary of War, but that they shall go at once to be settled by the Appeals Commission.

Substitute Bill the Best So Far

"This substitute bill would be of all the bills proposed the best bill, from the standpoint of both the public and the industrial interests whose patriotism caused them to proceed with necessary war work without awaiting formal contracts, if the provision giving appeal by the Department of Justice from the War Department's decisions were eliminated. It affords to the War Department the necessary powers to enable it to carry out its engagements with industry and would permit it to do that speedily except for the right of appeal of the Department of Justice.

"Speed in payment of the industries which did war work is absolutely vital in order that the industries may have use of their capital and thus employ the labor of the country and assist in preventing a bread line. Already the newspapers are carrying stories of unemployment, and it is clear that the situation will grow worse unless the industries which have been doing war work can receive payment from the Government so that they can immediately go back to peace production.

"The appeals clause referred to opens the way not only to delay payment on informal contracts, but on formal contracts as well, of which the War Department now has full jurisdiction and which are being settled.

"The right of one department of the Government to appeal from the decisions of another is an anomaly in the history of legislation. Such a provision, if it were incorporated in the legislation as finally passed, would prevent the expeditious relief essential. The Department of Justice would feel that the right cast upon it would be a duty, and it would have to organize forces to enable it to become advised and to pass judgment upon all the details in respect to each contract up for settlement that it might be able to ascertain which decisions of the War Department it should appeal. This could mean nothing other than intolerable and endless delay and disaster, because in few cases could it make such investigation in the 30 days allowed for appeal, and it would feel constrained to appeal every case in order that sufficient time could be allowed for it to make its investigation.

Appeal by Department of Justice Unnecessary

"There can be no reason for retaining the right of appeal in the bill except the feeling that there might be some cases in which some of the civilians who have been operating as officers of the War Department may at the time of letting the contract or at the time of settlement have been interested in some manner with the contractor. This reason is not substantial, however, because under section 3 of the bill there must be definite evidence that no such interest on the part of the office making or settling the contract exists before the War Department has the right to proceed. The section requiring this evidence provides that if the evidence is not forthcoming all such contracts must go immediately to the Appeals Commission to be disposed of. This affords adequate protection to the Government and to the public, and it is not just that tens of thousands of contracts should be held up indefinitely in their settlement in order to afford this supplementary and entirely unnecessary protection as provided in the clause giving the right of appeal to the Department of Justice, especially when it is recognized that the need for such protection, even if it existed at all, could be made necessary only in a minor fraction of the great body of contracts.

Contractors Should Have Right to Appeal

"Contractors should be given the right of appeal, however, because there could arise cases in which a manufacturer who went ahead on war work without a formal contract could be done a great injustice by some careless officer of the War Department. But to give the Department of Justice the right of appeal from the decisions of another Government department is absurd when the Government already is protected.

"The committee which I represent represents in turn, through the War Service Committees of the industries, substantially 90 per cent. of the industries of the United States, and it is convinced that this feature of the bill as set forth must be eliminated in order not to defeat the purpose of the legislation, which everyone agrees is necessary and which must be so phrased as to give relief at the earliest possible day."

We Need a Strong Ordnance Organization as Peace Insurance

It is not necessary for us to comment upon Mr. Defrees' remarks further than to state that reciprocity is a sound model by which to be guided and that our Government should give relief to its contractors and endeavor to act with the same celerity that these contractors exhibited in giving relief to the Government.

The New Ordnance Organization

THE reorganization of the Ordnance Department, which is now taking place, is designed to give the United States a permanent organization of a kind in keeping with both our nonmilitary aims and our possible military necessities.

The fact that we are and will continue to be a peace-loving nation is one of the strongest reasons for a proper ordnance organization. We were peace loving before the war, and the handful of officers that we considered sufficient to take care of our very limited expenditures for target practice and maneuvers, while high in quality, were sadly lacking in quantity—when the emergency came.

This condition had to be, for in the prewar days the American public had no conception of the size and complexity of an adequate ordnance organization, nor would it have been possible to obtain from Congress the necessary funds for the maintenance of such an organization.

Now we know how ordnance requirements in war time tax to the utmost the energies of engineers and industries. And, like Clemenceau of France, while all of us desire the abolition of war and wish the best of luck to the League of Nations most of us will be reluctant to relax into a comfortable state of unpreparedness until it is demonstrated that this League of Nations is actually going to work.

Soldiers Can Be Obtained Quickly But Ordnance Takes Time

That part of preparedness which is hardest to develop in a hurry when needed is the part to set in order first. Experience has proved that you can produce good fighting soldiers in two or three months, but that it takes a long time to produce good fighting ordnance. It is not so much due to the complexity of the individual articles of ordnance, although in many cases these things are complex enough, but the delay lies in the establishment of human relations—in the building up of personnel adequate to handle the complexities and ramifications of ordnance in war times. A dozen ordnance officers cannot be familiar with the scope and capabilities of 5000 manufacturing plants. And this acquaintance—in fact more than acquaintance, a perfect familiarity between the manufacturer and his engineers and the ordnance engineers—is requisite for efficiency in bending a nation's industries to war.

This new organization contemplates the development of an intimate knowledge on the part of ordnance engineers of the capabilities of American shops on one hand and on the other an equally thorough knowledge on the part of American shops of the requirements of American ordnance. It provides sufficient personnel for the obtainment of these ends and is built for speed as well as power—something that perhaps cannat be said of the old organization.

New Organization Fractional, Not Functional

This new organization divides ordnance material into a number of fractional parts, such as artillery; trench-warfare material automatic arms and small arms; aircraft armament; tank, tractor and trailers; artillery ammunition, metal components; explosives, chemicals and loading. Each of these divisions is in charge of one man who is responsible not only for the design and development of his material but for its procurement, production and inspection. These division heads report directly to a chief of manufacture, who has not yet been named but who is directly responsible to the Chief of Ordnance. Each division chief is specifically held responsible for the final obtainment of material within a specified period as to kind, quality, quantity, time and place of delivery.

Administrative District Offices and Field Service Cared For

In addition to the group of divisions under the Chief of Manufacture this new organization forms three parallel groups. The Chief of Administration has charge of the Administration Division, which, as its name implies, performs administrative functions for the various other divisions. The Chief of Districts has charge of all matters relating to the organization, location and operation of the ordnance district officers. The Chief of the Technical Staff approves all drawings and specifications, all changes and passes upon all proof tests of material. The Chief of Field Service is in charge of three divisions. The first of these has to do with the depots, dumps, rail heads, trains and other facilities for the handling, storage and delivery of ammunition. The second, the Maintenance Division, is in charge of base, advance and other shops and of the repair and maintenance of equipment in the field. The third, the Supply Division, has charge of the base and advance depots, rail heads, trains and storage for all ordnance material other than ammunition.

Gage Obtainment Needs Special Attention

This organization appears to be very admirably planned, combining as it does the possibilities for rapid expansion of personnel if needed, with a logical subdivision of duties, each of which is performed by a man who is provided with all necessary authority and held accountable for results. The one suggestion that it seems advisable to make for the improvement of this organization is the similar centralization of gage work under one division chief. The obtainment of gages for war work is of such primary importance that it should not be classified as a minor function of several divisions.

Work of War Committee of Technical Societies

The invaluable advisory work of the War Committee of Technical Societies, just dissolved, is little realized by the country at large. Some idea of what was accomplished may be gleaned from the statement that the committee passed on more than 110,000 ideas, suggestions and inventions. The work of the committee is to be carried on by the various engineering societies individually.

THE War Committee of Technical Societies, which has been operating in close coöperation with the Naval Consulting Board and with the General Staff of the Army, has had its work brought to an end by the termination of the war and ceased to exist on Dec. 31. To understand fully the history of this committee it is necessary to go back to the creation of the Engineering Council by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the United Engineering Society, which is described in the bylaws of the United Engineering Society as follows:

In order to provide for convenient coöperation between the four Founder Societies, for the proper consideration of questions of general interest to engineers and to the public, and to provide the means of united action upon questions of common concern to engineers, the United Engineering Society shall, in addition to its other activities and entirely separate therefrom, establish and maintain a department to be known as the Engineering Council . . . (Par. 116).

The council may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers, unless objection be made by a majority of the representatives present of one of the Founder Societies or by one-fourth of the representatives present and voting.

When war was declared the engineering and technical men of this country who by reason of age or business restrictions were unable to go to the front began to insist that some means be offered by which they could assist the Government in the study and prosecution of war problems. This feeling, after considerable agitation, resulted in the organization by the Engineering Council of the War Committee of Technical Societies at meetings held on June 27 and July 13, 1917. The functions of this committee, as defined by the officers of the Council in their published announcement, were as follows:

To assist any organization in Washington, such as, for instance, the Council of National Defense, the National Research Council, and the Naval Consulting Board, in any way in which it can bring to the attention of the engineers of the country the necessity for thought and help in the numerous problems that arise in the prosecution of the war.

Membership Not Restricted to the Four Great Societies

That the War Committee should cover as broad a field as possible and afford full facilities to the technical men of this country to utilize their inventive talent for the benefit of the Government membership in this committee was not restricted to the four great national societies, but other technical organizations were invited to join, with the result that the committee now consists of two members from each of the following societies: The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Electro-Chemical Society, the Mining and Metallurgical Society of America, the Illuminating Engineering Society, the American Gas Institute, the American Society of Refrigerating Engineers, the American Institute of Chemical Engineers, the Society of Automotive Engineers and the American Society of Heating and Ventilating Engineers. The American Chemical Society also coöperated, and the officials of the committee were as follows: Chairman, D. W. Brunton; vice chairman, Edmund B. Kirby; secretary, Capt. Lloyd N. Scott; treasurer, Preston S. Millar.

Chairman's Report

The chairman's report of the activities of the committee states that when the War Committee was first organized on June 27, 1917, its membership consisted of two delegates from each of the four Founder Societies. Harold W. Buck was chosen as its chairman, and remained in office until pressure of private business compelled him to resign on Sept. 24, 1917. The present chairman was then elected, and as he was anxious to "do his bit" and was too old to go to the front he has devoted his entire time and attention to the work of the committee since that date.

Finding that the appropriations from the Engineering Council were too small to enable us to work efficiently, continues the chairman, we accepted an offer from the Naval Consulting Board on Oct. 2, 1917, by which we agreed to coöperate with officials of the board, they to provide us with an office, telephone service and postal privileges. This arrangement has operated most satisfactorily, and under it the two bodies were able to put out a bulletin on "The Enemy Submarine" and later one on "Problems of Aeroplane Improvement." The printing, mailing and other expenses incidental to the sending out of these bulletins were provided for by the Naval Consulting Board appropriation and approved by the Navy Department.

Value of the Bulletin

These bulletins in a measure achieved the desired results, as they placed before the engineers of this country in concrete form some of the requirements in both the submarine and aircraft branches of the service and brought to the War Committee and the Naval Consulting Board a much better class of suggestions, ideas and inventions than they had before been receiving. During the prosecution of the war new problems of all kinds were constantly coming up in both the Army and Navy, but it was found extremely difficult for us to obtain these at long range.

With the erection and occupancy of the new Navy Building space was provided for the office of the Naval Consulting Board, consisting of the resident member, who is also chairman of the War Committee, and a staff of examiners, which office was directly connected with the office of the Secretary of the Navy. In this office space was also provided for the work of the War Committee

of Technical Societies. This has resulted in the concentration of all work in connection with the Navy Department and has brought the committee in much closer touch with service officials.

The first necessity in successfully maintaining an office at Washington was a capable secretary, but owing to the high cost of living in that city we were unable to find anyone with the necessary qualifications for this important office who was willing to volunteer his services. At this juncture the General Staff of the Army offered to aid us by appointing a liaison officer who should be free to devote half his time to War Committee work.

After due consultation with the chairman and the secretary of the Engineering Council this offer was accepted, and Capt Lloyd N. Scott of the Inventions Section of the General Staff was appointed liaison officer to the War Committee, and at a meeting of the board held in New York on Sept. 10 he was elected secretary. This arrangement has proved most satisfactory to the Army, the Naval Consulting Board, and the War Committee, as Captain Scott is a staff officer with a wide experience in engineering and business undertakings, which, combined with forcefulness and tact, has made it possible for him to achieve wonderful results under conditions such as now exist in Washington.

War Problems Classified

The war problems received from the Army and Navy may be grouped into three classes: (a) Those which are suitable for general distribution to our members by means of bulletins and letters; (b) semiconfidential problems which are sent to selected individuals and groups of inventors who are known to be interested in that particular class of work; (c) strictly confidential problems, the solution of which requires the highest order of technical information and which can be sent only to carefully selected scientists and prominent inventors whose life study has fitted them for the work in hand.

These problems are always mailed in double envelopes, the outer one giving no trace of its contents, and the inner envelope marked "private and confidential." At present the outstanding problems in Class C relate principally to submarine detection devices, aeroplane instruments, especially those required in cloud and night flying, and liaison devices for communication between the advancing front of an army and the artillery protecting them at the rear.

The War Committee, in sending out both bulletins and letters, requested our members to forward all ideas, suggestions and inventions on naval warfare to the Naval Consulting Board, and on land warfare to the inventions section of the General Staff. The material received in response to our bulletins and letters ranged from aeroplane supercharges and fuel for high-altitude flying, down to submarine detectors and depth bombs; from long range guns to trench knives; from observation balloons to tunneling machines, and from caterpillar tanks to radium sights.

Up to date more than 110,000 ideas, suggestions and inventions have been received and passed upon by the Navy Department and the Naval Consulting Board, either separately or conjointly, and the Inventions Section of the General Staff, which is a much younger organization, has already handled over 25,000. The crest of the inventions wave for the Navy Department and the Naval Consulting Board was reached in the early months of the war when the receipts amounted to as high as 600 a day, and that of the Inventions Section of the Army in July last when they received 124 a day. All the material received by both organizations is subjected to careful study and consideration by specialists, and those inventions deemed to have merit are immediately sent to the department of the Army or Navy where they can be most readily utilized.

Classes of Inventions

Inventions as received by the Naval Consulting Board and Inventions Section of the Army may be roughly divided into four classes: (1) Those which have no intrinsic or suggestive value; (2) those which, though having no real value in themselves, suggest new lines of thought and investigation; (3) inventions which have considerable promise, but are not yet developed to a point where it is possible to pass judgment on them, and (4) inventions which are sufficiently perfected so that they can be investigated and tested.

Ample facilities for testing inventions of the fourth class are now provided by the Bureau of Standards and Bureau of Mines in Washington. The ideas, suggestions and inventions belonging to classes 2 and 3 are, of course, much more numerous than those of Class 4, and the necessity of providing some means of solving problems and developing inventions has long been apparent. In many instances the inventors have neither the funds, scientific knowledge nor mechanical skill to perfect their own inventions, hence aid in each of these directions is necessary so that the country may reap the full benefit of the originality of its citizens.

In its financial relations the committee has been singularly fortunate, as owing to the generous support given by the Navy Department, the Naval Consulting Board and the Inventions Section of the General Staff it has expended only $1843 of the $4700 appropriated by the Engineering Council, and all of the funds contributed by organizations not included in the four Founder Societies are still intact in the hands of the treasurer.

Danger of Lack of Engineer Officers

The Great War, which has just been brought to such a glorious conclusion, has given us all a realization of the dangers of inadequate preparation for national defense. In no department has this been felt so severely as in the scarcity of engineering officers and the ignorance of military affairs on the part of those that were obtainable. To benefit by past experience we must insist that in every engineering school the students are given thorough military training. The last war and the wars in future will be engineers' wars, and it is to the engineers that the country must look for officers to supplement the efficient, highly trained but numerically inadequate supply graduated from West Point and Annapolis.

Now that the war is over the Government can scarcely expect continuous volunteer service from our members, and after consultation with all of the parties at interest it has been decided that though the engineers

of this country still maintain their readiness to assist the Government in every possible way it will be more economical and convenient for the Army and Navy to function with the members of the societies which united to form the War Committee of Technical Societies through the secretaries of these organizations. For this reason the Engineering Council has asked that the committee be dissolved on Dec. 31, at which time our appropriations will cease.

Lists of the officials and membership of the societies included in the War Committee have been filed with the War and Navy departments, and their officials have been requested to continue the work which has heretofore been carried on by the War Committee of Technical Societies through the secretaries of these different organizations, an arrangement which I have no doubt will prove extremely satisfactory to all concerned.

Pipe Dreams of a Tramp Machinist—Why the Super Drove Slowly

By Glenn Quharity

Tom was master mechanic of a fair-sized manufacturing plant in a small Middle-Western town located about 30 miles distant from the Great City.

Tom was a thrifty fellow—owned his own little home where he, the wife and kiddies lived "happily ever after" and where he spent many contented hours when his day's work was done puttering around the house, putting a few bricks on the chimney where the old mortar had worked loose or new boards in the veranda flooring where Jr. had chopped a hole with his Christmas hatchet, and doing all such necessary and unnecessary jobs as fall to the lot of men who have a house of their own and enjoy living in it.

Just at the season of which I write Tom was engaged during his spare time in putting a new window in the living room to let in more of the morning sun. Late one Saturday afternoon he might have been seen coming out of the principal hardware store of the distant city and heading up the street in the direction of the railroad station, carrying gingerly under his arm a long, flat package wrapped up in brown paper.

As Tom was nearing the station a "long, low, rakish craft" came droning up behind and stopped abreast of him. It was Mr. Williams' new 1920 model twin-six Jacquard with Mr. Williams—Tom's superintendent—himself at the wheel.

"Goin' home, Tom?" called Mr. Williams.

"Sure thing," replied Tom.

"Climb in," and Mr. Williams opened the door for Tom to get in beside him.

Tom deposited his bundle tenderly on the seat, got in and closed the door. Mr. Williams turned on the gas and they began to fade quietly out of the city and onto the 30-mile stretch of not too good pike that led homeward.

Mr. Williams was an enthusiastic motorist and his cars always ran like well-oiled sewing machines—Tom personally saw to that—consequently when they had cleared the city traffic and Mr. Williams had "widened 'er out" a little, long rows of telegraph poles began to flash by on either side with astonishing rapidity and the ordinarily widely separated houses along the way took on an aspect of being quite friendly and close together. There also seemed to be an unconscionable number of vehicles bound toward the city.

About half way home, after they had described a narrow radius arc around a 5-ton truck loaded with 7 tons of pig-iron which was headed in the same direction as they were, Mr. Williams noticed that Tom was cringing away from the place where a telegraph pole had recently threatened to come aboard (everybody knows that a Jacquard 1920 is a left-hand drive and that Tom was therefore on the off side) and that he was hugging his bundle jealously under the arm next to the driver.

"Scared, Tom?" queried Mr. Williams.

"No-o-o," said Tom.

Mr. Williams gave his attention for a fraction of a second to gaging the approximate number of sixty-fourths between him and a passing touring car and then, turning to Tom who was nursing his bundle even more tenderly than before, inquired: "Afraid of smashing something in your bundle?"

"It might bust up some if I got too brash with it," admitted Tom. "You see it's a half dozen sticks of dynamite that I hope to use to blow out that ledge outcrop in my back yard."

The humming motor commenced to lower its high-pitched pur until it had become a hoarse growl. The car glided sedately along the smoothest part of the roadbed, carefully avoiding passing vehicles by generous margins, and once upon approaching a farm wagon pulled by a pair of mild-eyed oxen the aristocratic appearing automobile drew carefully to one side of the road and stopped while the team went by.

Eight miles an hour was the limit for the rest of the journey, and when the buzz wagon finally drew up to Tom's gate Tom was lolling back comfortably on the seat with his bundle on his knees while Mr. Williams sat erect, looking as if he were worried about something.

As Tom rose to get out, the bundle tilted sidewise. There was a sound of tearing paper, and a long sinister-looking cylindrical object started endwise toward the floor of the car at the same moment that Mr. Williams with a yell like a wild Indian started to climb over the wheel.

Too late! The cylindrical object caught Mr. Williams' foot just before he got fairly started on his sky ward flight.

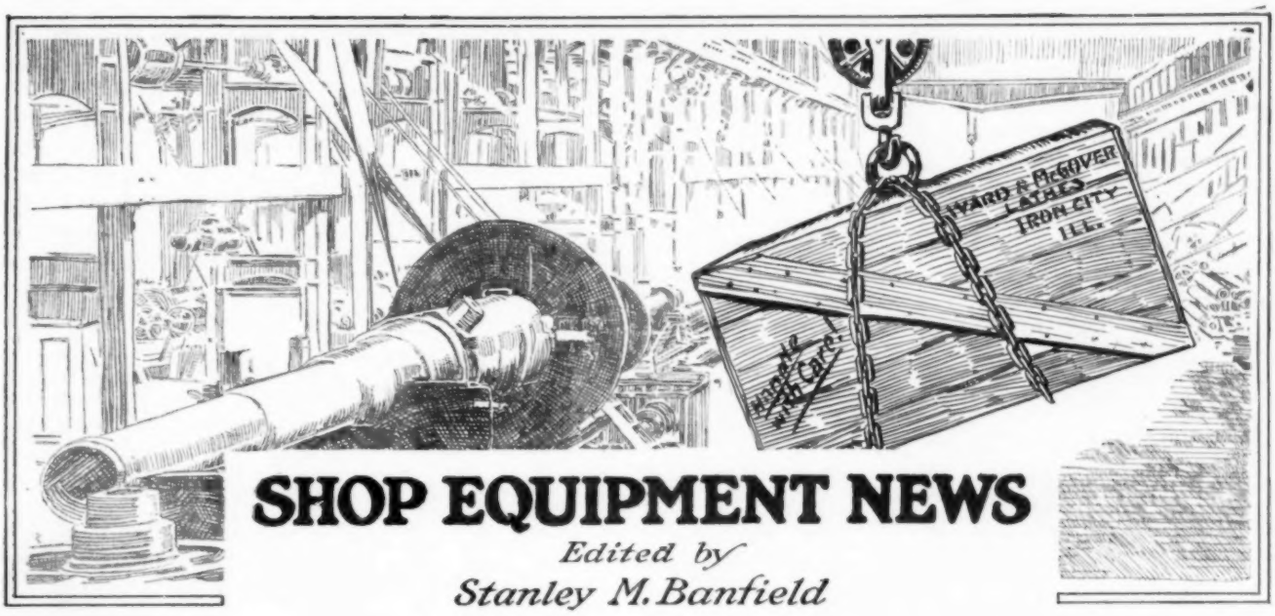
The trouble is not entirely patched up yet.

The sinister-looking object was a window weight.

Value of Training Employees

Since the beginning of the new year the Department of Labor has received requests from 12 large plants in New York State for assistance and advice in directing the establishment of training rooms that will embody all the best ideas for the careful conditioning of employees for better service. As a preliminary, plant surveys will be made by experts of the Training Service, and this work will be started at once.

The extent to which employers are awakening to the value of training is shown in the fact that a transcontinental railway has asked that a survey be made of its great shops and extensive lines with a view to making provisions for the training of its personnel, which includes thousands of employees.



SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Saphil Electric Grinding Machine

The illustrations show a new portable electric tool, cutter and surface grinding machine that has recently been placed on the market by the Saphil Manufacturing Corporation, 149 West Austin Ave., Chicago, Ill. Fig. 1 shows the complete motor-driven grinding attachment. It is designed to be placed over the toolpost on the lathe, and is held in place by means of the regular toolpost screw which is tightened down upon a bar slipped through the hole in the toolpost. An adjustment is provided which permits the grinding spindle to be raised or lowered to any necessary position, this adjustment being accomplished by means of a micrometer screw. The motor is supported on two vertical bars, making it possible to raise or lower it as desired to adjust the belt tension. The spindle is driven from the motor by means of a flat belt. The spindle runs on double self-aligning ball bearings. The machine is ordinarily equipped with either a $\frac{1}{10}$-hp., 110-volt, direct-current, compound-wound, 3500-r.p.m. motor, or a 110-volt, alternating-current, single-phase, 60-cycle motor with an operating speed of 3400 r.p.m. The machine can also be equipped with a $\frac{1}{4}$-hp., 110- or 220-volt motor if this is desired. Fig. 2 shows the machine attached to a cutter and surface grinding outfit with a 12 x 12-in. surface plate, the cutter being in use for grinding a milling-machine product. Milling attachments can also be furnished if these are desired. The machine complete weighs 26 pounds.

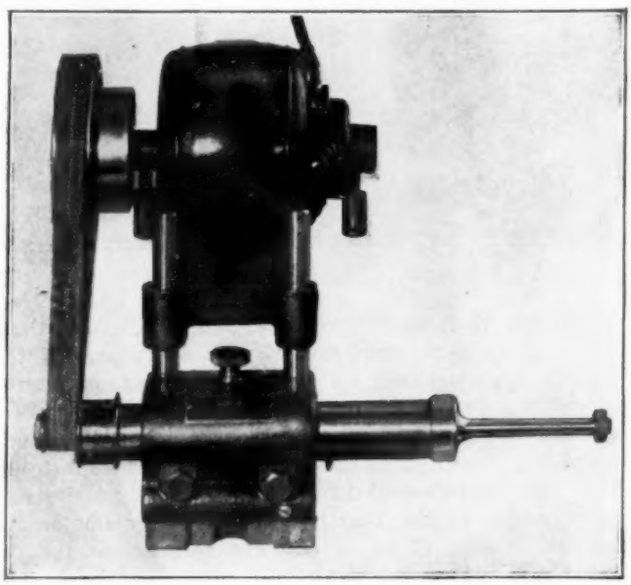


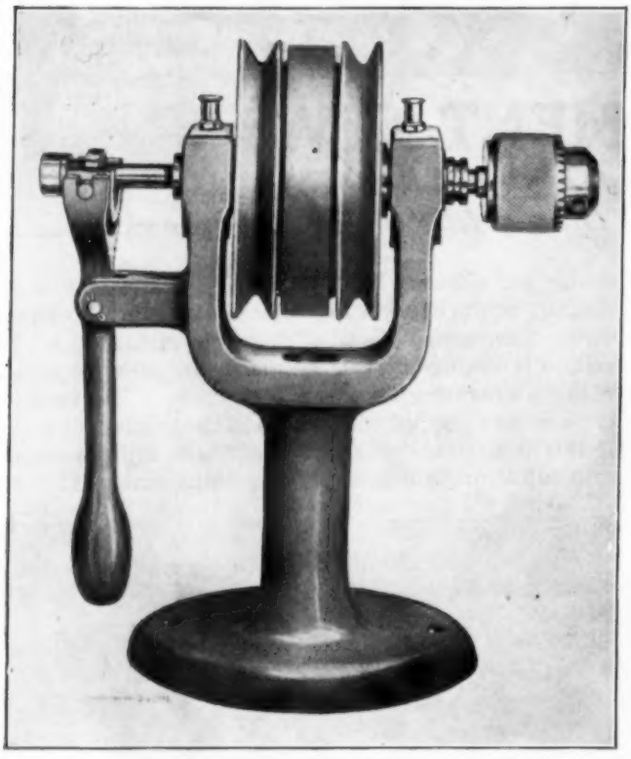
FIG. 1. A FRONT VIEW OF THE SAPHIL MOTOR-DRIVEN GRINDING ATTACHMENT

FIG. 2. THE GRINDING ATTACHMENT MOUNTED ON THE SPECIAL SURFACE PLATE

Harris Thread-Gage Lapping Machine

The H. E. Harris Engineering Co., 1047 Broad St., Bridgeport, Conn., has recently placed on the market the thread-gage lapping machine shown in the illustra-

tion. The drive to the spindle is from either of the two grooved pulleys through the double cone-shaped spider. In designing the machine it has been the intention to include such features as would be conducive to the comfort of the operator. His left hand and arm rest upon the bench and a slight pressure with either the thumb or index finger will cause the lapping spindle to drive in the desired direction. In lapping female gages the lap is held in the chuck and the gage in the operator's right hand. His right elbow rests on a pad on the bench, thus taking the weight of his body and leaving the muscles of his hand, fingers and wrist free for the



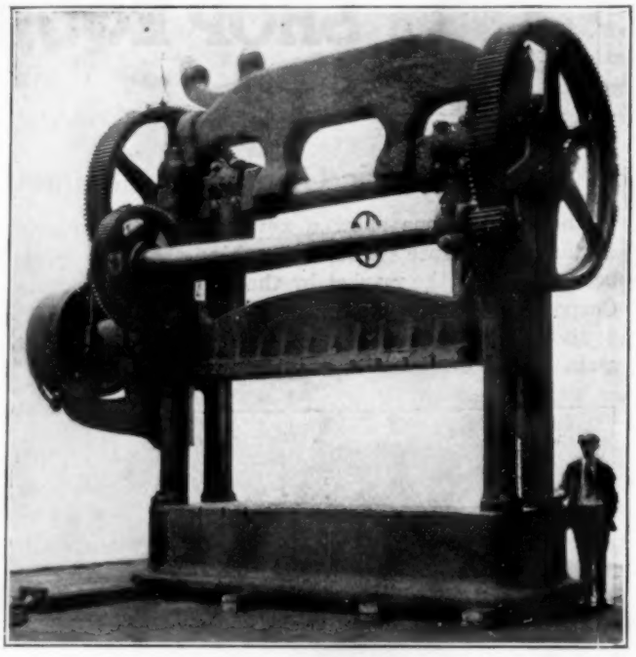
HARRIS THREAD-GAGE LAPPING MACHINE

lapping operation. In lapping male gages the gage is held in the chuck and the lap is in the operator's hand. The drive is at high speed, and is communicated from the groove pulleys by the spider which is fastened directly to the spindle, the friction surfaces being leather faced. It is said that the drive is so smooth that the reverse cannot be detected by the eye and that there is no shock in reversing. The reversing mechanism requires a very slight movement of the spindle, probably 0.01 in., this being obtained by pressing on the vertical lever shown at the left. The upper end of the lever carries a yoke and a ball thrust bearing in order to overcome friction at this point. When there is no pressure on the lever the ball weight at the lower end holds it in vertical position, which is the neutral point in its motion, the spindle remaining at rest. It is stated that the spindle is reversed in one-quarter of a revolution.

500-Ton Ferracute Press

The Ferracute Machine Co. Bridgeton, N. J., has recently built the large press shown, which is known as press S-507, designed for pressures up to 500 tons. The tensile stresses are taken by four 5½-in. steel rods that are shrunk in the cast-iron columns. The ram has a vertical motion of 18 in. and makes between 5 and 6 strokes per minute. The distance between columns, right to left, is 148 in., and from bed to ram at top of stroke and adjustment, 60 in. Power is applied through the medium of a combined friction clutch and brake, by means of which the operator is given complete control of the action, it being possible to start or stop the press at any part of the stroke, or to run continuously, or to have the ram stop automatically at the top of the stroke each time.

Attention is called to the tapered back shaft, a construction which is said to be unique. The reason for having this shaft a larger diameter at its driven end is to equalize the torsion so that both the large gears will



500-TON FERRACUTE PRESS

be driven with equal pressure tangentially on their teeth. This is accomplished by the short part of the shaft being elastically twisted only to the same degree of rotation as is the long part, which, if the shaft were parallel the whole length, would of course twist much more on account of its length than would the short section. As the torsional deflection of a shaft under stress is inversely as the fourth power of its diameter the proper amount of taper required to produce the desired result is easily calculated.

A method formerly used to insure equal pressures at the ends of the back shaft was to place the driving gear in the middle of the shaft, but this involved a somewhat unwieldy outrigger or bracket to carry the journal box of the clutch shaft and also required great care in the mechanical operations when the press was under construction, since it was essential that all the journals of the clutch shaft should be exactly aligned. Placing the gear at one end and giving scientific proportions to the shaft obviate the objections mentioned, and also enable the clutch shaft to be much shorter than by the old design and uniformly of standard length. The total weight of the press is about 137,000 pounds.

Connecticut Universal Grinding Machine

The machine shown in Figs. 1 and 2 is made by the Middlesex Machine Co., Inc., Middletown, Conn. Fig. 1 shows the machine set for cylindrical grinding, and Fig. 2 fitted with a magnetic chuck and set for surface grinding. The machine is rigidly built and has ample bearing surfaces and substantial column and head construction, which insure rigidity and freedom from vibration. It is very efficient on light, extremely accurate work, as well as on the general run of work. Its range includes rapid and accurate production of straight or taper work between centers, surface grinding, internal grinding, cutter and reamer grinding and all general toolroom grinding. The wheel head carrying the main grinding spindle is a heavy casting bolted to the column which is solid with the base. The spindle is of tool steel hardened, ground and lapped. It is mounted in SKF ball bearings and fitted with special adjustable bronze bushings which effectually eliminate all end play. The spindle has a 15-deg. taper on each end. Flanged bushings fitting these tapers are furnished, making it possible to change the wheels and maintain their true relation to the work without the necessity of retruing the wheels.

The internal grinding attachment is bolted to the spindle head and is made adjustable to give the proper tension to the belt.

The column construction allows the table to be swung completely around the head, yet the table is supported by a knee slide similar to that of a milling machine. The top platen rests for its full length on the main table casting. It is made to swivel and has a knurled-head thumbscrew for accurate adjustment. The table is operated by rack and pinion and is furnished with automatic feed. The cross-feed screw has micrometer adjustment. The water supply is piped direct from the pump to the wheel hood, doing away with the leaky hose connection.

The regular equipment furnished with this machine includes one machine countershaft, one drum countershaft, one universal attachment, one 4-in. three-jaw chuck with wrench, one gear cutter-grinding attachment, one internal grinding attachment with driving pulley, belt and one spindle extension, one universal headstock fitted with drawback attachment, one headstock bushing with pulley fitted to carry either chuck or faceplate, one tailstock with center, one faceplate with taper shank, one expansion collet for faceplate, one wrench for ½-in. nut, three T-slot bolts and six dogs, assorted sizes.

FIG. 1. CONNECTICUT UNIVERSAL GRINDING MACHINE

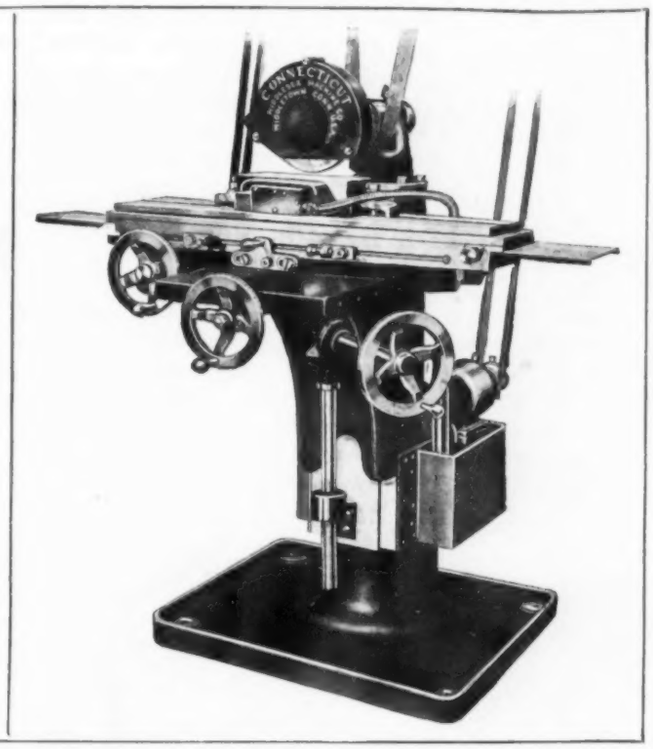
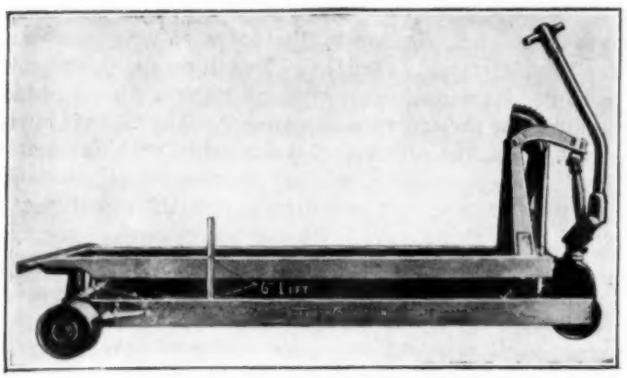


FIG. 2. MACHINE FITTED FOR SURFACE GRINDING

Specifications—Spindle, 1⅛ in. in diameter; front bearing, 4½ in. long; rear bearing, 3¼ in. long; longitudinal movement of table, 19 in.; vertical movement of table, 13 in.; transverse movement of table 8½ in.; centers swing work up to 12 in. in diameter; centers swing work up to 24 in. long; working surface of table, 5¾ x 34 in.; maximum distance spindle to table, 9 in.; height, floor to center of spindle, 45 in.; column, 7 in. in diameter; spindle belt giving increased power and no slipping, 2½ in. wide; universal attachment swings cutters 12 in. in diameter; chuck, 4 in. in diameter; faceplate with expansion drawback, 6 in. in diameter; headstock has No. 10 B. & S. taper; headstock, dead center, has No. 6 Jarno taper; net weight complete with attachments and countershaft, 1700 lb.; net weight complete with attachments boxed for foreign shipment, 2000 pounds.

"Jacklift" Type G Elevating Truck

The Louis Sheppard Co., 48 Binford St., Boston, Mass., has recently placed on the market a jacklift elevating truck, which is known as type G. The particular feature of the truck is that the load may be elevated 6 in., and it is claimed that it is the only elevating truck in the market that lifts the load over 3½ in. It is also claimed that the 6-in. lift is very handy where the load must be trucked over steep inclines and that it may be



THE "JACKLIFT" ELEVATING TRUCK

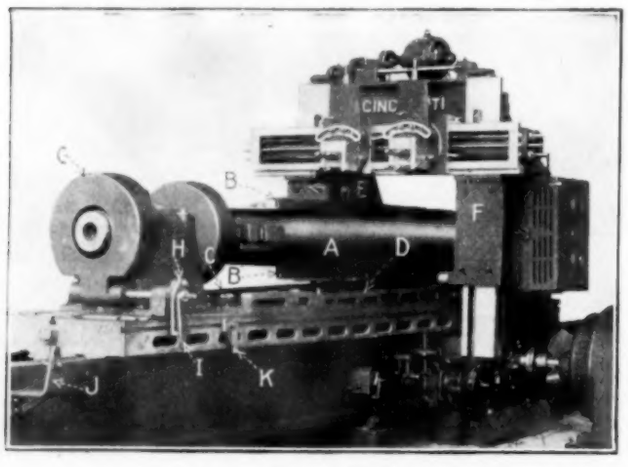
used to great advantage in taking battery cradles, with the battery intact, from an electric truck. This truck contains the usual features of the jacklift line, principal among which are easy lift, vertical lift and free lifting handle. The type G truck is made in 10 models and five different lengths. Each may be equipped with either 8- or 10-in. wheels as desired.

Cam Rails Used in Planing Howitzer Jackets

BY E. A. THANTON

Owing to the recoil ways for the 9.2-in. howitzer being made solid with the tapered jacket it is impossible to turn off the surplus metal. For this reason the Cincinnati Planer Co. fitted up one of its big planing machines to do the work as shown.

The howitzer jacket held on special centers is shown at *A*, the two recoil ways being indicated at *B*. In order to cause the tool to follow the taper of the jacket cam rails *C* and *D*, which are exactly alike, are placed one on each side of the table. Bolted to each end of the cross-slide are brackets *E* and *F*. These brackets carry rollers which ride on the cam rails and give the cross-rail the necessary vertical movement for the tool to follow the work. The jacket is automatically rotated for the feed by means of a worm gear under guard *G*, and a worm operated by the ratchet mechanism *H*. The ratchet lever *I* receives its impulse when it strikes the pin *J* on the back stroke of the table. One of the regular table reverse dogs is shown at *K*.

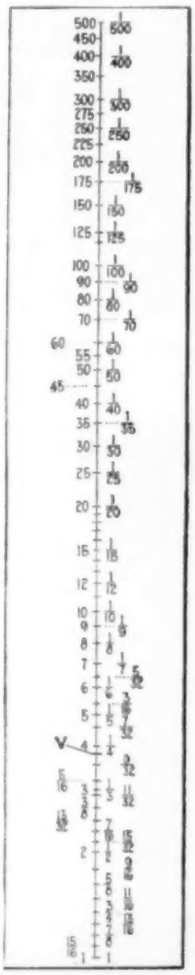


PLANING HOWITZER JACKETS

Universal Lathe and Grinder Chart*

BY R. POLIAKOFF

Assistant Professor of Mechanical Technology, Technical Institute, Moscow, Russia, pro tempo New York



THE CHART AND HOW TO USE IT

On page 590, Vol. 49, of the *American Machinist* a chart compiled by the author was shown enabling one to find in a very convenient and quick manner the time required to turn a bar in a lathe or to grind it in a grinding machine. Herewith is shown how the same chart without any alteration in it can be used to find the number of revolutions per minute if the speed and diameter are known. The rule to proceed with is as follows:

Take the vertical distance between the numbers on the chart representing the speed *in feet* per minute and the diameter *in inches* and set it off from the division marked *V* on the chart upward if the number representing the speed is above the diameter number, and downward if the number representing the speed is below the diameter number. The result will show the number of revolutions per minute.

As the number expressing the speed in feet is usually larger than the diameter expressed in inches one will have to set off in most cases the distance upward from the division marked *V*.

Example 1—Speed, 150 ft.; diameter, 20 in.; number of revolutions, 28.5.

Example 2—Speed, 30 ft.; diameter, 40 in.; number of revolutions, 2.9.

Screws Used in Instrument Making

There seems to be a lack of knowledge regarding the sizes of screws used in instrument making. The table below is used in some of the larger instrument shops:

No.	Diameter	Threads per Inch
0	0.06	80
1	0.073	72
2	0.084	56
3	0.0973	48
4	0.1105	36
6	0.1368	32
8	0.1631	32
10	0.1894	32

The first two sizes are A. S. M. E. standard, and the whole A. S. M. E. series is to be preferred even though it is difficult to obtain the screws as very few concerns carry them in stock. On account of the finer threads the A. S. M. E. screws are better where there is much vibration. When the screws given above work or jar out too readily it is customary to substitute No. 2-64, No. 3-56 and No. 4-48 from the A. S. M. E. list.

Above the 10-32 size the S. A. E. list is used almost exclusively, owing to the fine threads.

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LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft • Motor Trucks • Tractors

To enable America to take the lead in the conquest of the air John D. Ryan, who recently resigned as director of the Aircraft Production Board, has proposed to the United States Government the establishing of an academy of aeronautics similar to West Point and Annapolis.

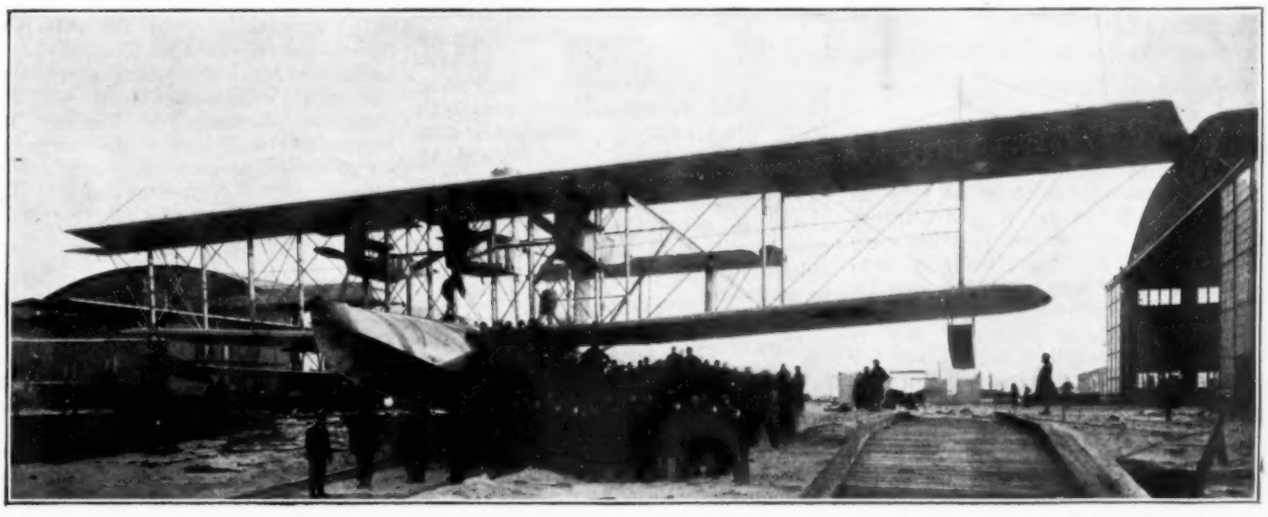
A new world airplane altitude record of 30,500 ft. was established at Ipswich, England, on Jan. 3, 1919, by Captain Lang, carrying an observer, Lieutenant Blowers. Both pilot and observer were suffering from frostbite on account of the cold experienced at 30,500 ft., which registered 38 deg. F. below zero. "For the first 8000 ft., the machine was tossed and buffeted about by a 25-mile gale, but after that the going was smooth," said Captain Lang. "The sun was bright and we could make out ships plainly several miles to sea. At 28,000 ft. our oxygen ran short. Blowers fainted and was unconscious until we landed, but I was lucky enough to stick it out." The previous airplane altitude record was 28,900 ft., established Sept. 18, 1918, by Capt. R. W. Schroeder of the Wilbur Wright Aviation Field.

An experimental airplane built by the Carolina Aircraft Co., using wood veneer in the wing construction not only for ribs but also for the actual wing covering, was tested with satisfactory results by the National Advisory Committee for Aeronautics. It was found that the internal drift wires may be eliminated and the same weight per square foot of service obtained as in the ordinary wing constructions.

Launching an airplane from a dirigible was successfully carried out by the United States Navy Department. An airplane was attached by a 100-ft. cable to the dirigible. Both rose to about 3000 ft., and the airplane was released. After diving about 1000 ft. the airplane obtained sufficient speed to continue its usual flight. In a similar line, the Glenn L. Martin Co. had a contract with the United States Government to construct a large bombing plane with a smaller pilot plane fastened to it, so as to automatically control the larger plane and direct its course after the smaller pilot plane had been released. This plan was never completed, as the order was cancelled when hostilities ceased.

The Aerial Transportation Committee has been organized by the Aero Club of America, with Rear-Admiral Robert E. Peary as chairman. The purpose is to coöperate with the Post Office Department in establishing aerial mail lines and to advise any business organization in the United States interested in this line in establishing aerodromes.

An interesting feature on the Gray tractor, model of 1919, manufactured by the Gray Tractor Co., Minneapolis, Minn., is the very simple design of the gearset. It has no bevel gears nor differentials. In all there are but six gears cut from drop-forged heat-treated steel blanks. The gearset is completely inclosed and runs in oil. The final drive is accomplished by a heavy-duty roller chain made of heat-treated nickel steel inclosed and running in oil. It is driven by hardened driving sprockets on both ends of the jackshaft and runs over cast-steel sprockets on the drive hubs which are attached to the ends of the drum, not to the axle. The drum is driven evenly from both ends, and power is transmitted to the rims through the riveted and solid ends. The chain drive is spring mounted.



CURTISS FLYING BOAT N.C.-1

The naval flying boat N. C.-1, the largest seaplane in the world, which carried recently 51 passengers in a trial flight at the naval air station at Rockaway, N. Y., was built by the Curtiss Engineering Corporation, Garden City, L. I., to the design of the Bureau of Construction and Repair of the Navy Department. The hydroplane has a 126-ft. wing spread, giving approximately a wing area of 2700 sq.ft. Both upper and lower wings of 2 deg. of incidence have a chord of 12 ft. and a wing gap of 14 ft. near the boat and 12 ft. at the wing tips. The lower plane has a 5-deg. dihedral. The over-all length of the machine is 70 ft., while the height is 25 ft. The power plant consists of three low-compression 350-hp. Liberty motors, each driving a four-bladed propeller. The total weight of the machine, with full load, is 22,000 lb. when carrying 900 gal. of gasoline, which is sufficient for a 13-hour flight. The usual crew consists of five men. The speed of the N. C.-1 is 45 knots on water and 80 miles in the air. The hydroplane is of the boat-body type and leaves the water after a 1000-ft. run. It draws 21 in. light and 31 in. with full load. The N. C.-1 on its trial made a trip from Rockaway, N. Y., to Washington, D. C., via Hampton Roads, about 350 miles, in 5 hours and 30 min., reaching an altitude of 2000 ft. in 10 minutes.

Sparks from the

Personnel of New Ordnance Divisions

Disposition of Work in Various Arsenals Will Afford Greater Degree of Specialization

The following are the assignments of officers under the new Ordnance office orders reorganizing this department. The chief of manufacture has not yet been named: Assistant Chief of Ordnance, Brig.-Gen. W. S. Peirce; Chief of District Offices, Brig.-Gen. W. S. Peirce; Chief of Technical Staff, Brig.-Gen C. L'H. Ruggles; Inspector of Ordnance Establishments, Col. W. W. Gibson; Chief of Administration Division, Col. W. W. Gibson; Chief of Artillery Ammunition, Metal Components Division, Col. E. M. Shinkle; Chief of Artillery Division, Col. G. F. Jenks; Chief of Automatic Arms and Small Arms Division, Col. Earl McFarland; Chief of Aircraft Armament Division, Col. Earl McFarland; Chief of Ordnance Field Service, Col. J. C. Heckman; Chief of Explosives, Chemicals and Loading Division, Col. C. T. Harris; Chief of Trench Warfare Division, Lieut.-Col. E. J. W. Ragsdale; Chief of Tank, Tractor and Trailer Division, Lieut.-Col. H. W. Alden.

How Work Will Be Assigned

Disposition of work in various manufacturing arsenals is to be as follows: Watertown is to be a gun-forging, steel-casting and armor piercing projectile plant for manufacturing seacoast gun carriages and the heavier types of mobile-gun carriages not mounted on wheeled mounts. Watervliet is to be retained as a plant for the development and manufacture of guns of all caliber up to 18 in., and is to be further expanded and equipped for the manufacture of 75-mm. guns by the transfer of machinery from war plants. Rock Island Arsenal is to be retained for the development and manufacture of field-artillery material, tractors and tanks. Springfield is to be retained and expanded for the development and manufacture of rifles, machine guns and pistols. New buildings are to be erected and equipped by government-owned machinery from commercial plants. Frankford is to be retained as a plant for the development and manufacture of small-arms ammunition, optical instruments and gages. Aberdeen Proving Ground is to be developed as a training and instruction center and as the main experimental station and proving ground for the department. The Erie Proving Ground is to be retained for the development and proof of artillery projectiles. Savannah Proving Ground is to be operated as a subpost of Rock Island Arsenal.

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Work on State Highways

The Bureau of Public Roads of the United States Department of Agriculture has collected from the highway departments of the various states figures indicating the probable number of returned soldiers and sailors that can be used during the present year in connection with road construction and repair. Replies were received from 38 states, but only 29 gave definite figures. These include the use of nearly 12,000 as skilled workers and nearly 92,000 as unskilled workers. The skilled workers include masons, carpenters, quarry bosses, concrete finishers, road foremen, roller men and superintendents.

* * *

Exporting American Goods to Russia

Russia soon will be receiving American goods again. The War Trade Board is receiving applications for exportation of all commodities through Vladivostok. A limited amount of cargo space may be available from Pacific Coast cities direct to Russia's eastern port. In allocating space preference will be given to material covered by licenses issued on and after Oct. 7 under conditions which the War Trade Board is prepared to define and to discuss with exporters, giving due consideration to the particular transaction in question.

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The New "Infant Industry"

The total value of dyestuffs exported in the fiscal year 1918 was $17,000,000 against $12,000,000 in 1917, $5,000,000 in 1916, $1,000,000 in 1915 and less than $500,000 in 1914, the year preceding the war. Prior to the war the export of dyes and dyestuffs had never exceeded $500,000, while imports of dyestuffs prior to the war aggregated from $10,000,000 to $15,000,000 a year. Dyestuffs exported to Great Britain in the fiscal year 1918 totaled over $2,500,000 against $70,000 in the year before the war; to France, $1,630,000 against $2000 in the year preceding the war; to Italy, $1,182,000 against $11,000 in 1914; to Japan, $3,233,000 against nothing in 1914; to India, $1,948,000 against $93 in 1914, and to Brazil, $1,282,000 against $65 in 1914.

Elected President of the New England Foundrymen's Association

Robert E. Newcomb, superintendent of the Deane Works of the Worthington Pump and Machinery Corporation, was elected president of the New England Foundrymen's Association at a meeting at the Exchange Club, Boston, Jan. 8, 1919.

Mr. Newcomb completed his engineering training at Sibley College,

ROBERT E. NEWCOMB

Cornell University, and was graduated in the class of 1907 with the degree of mechanical engineer. He then entered the Deane Works where he has been superintendent for the past 10 years.

He is a member of the American Society of Mechanical Engineers; associate of the American Institute of Electrical Engineers; member of the American Society for Testing Materials and chairman of the committee on packings, gaskets and pump valves; member of the New England Foundrymen's Association and a member of the National Founders Association.

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A Century of Trade Progress

It was just 100 years ago that the little steamer "Savannah" built in New York for transatlantic experiment passed out of New York to Savannah, which port it left a few months later on its successful venture across the ocean, to which the steamship was up to that time unknown. By 1850 world international trade had grown to $4,000,000,000, by 1900 it was $20,000,000,000, by 1913 $40,000,000,000, and in the year just ended probably $50,000,000,000 when measured in the inflated currency of the present period. Meantime world railways had grown to 725,000 miles. It is difficult to realize that only one hundred years ago the world had no steamship crossing the ocean, not a mile of railway or a foot of telegraph or ocean cable, while as for telephones, wireless telegraphy or airplanes they are the product of this generation.

World's Industrial Forge

By E.C.Porter, News Editor

Chief of the Division of Safety Engineering Appointed

H. H. Cannon has been appointed chief of the Division of Safety Engineering, Working Conditions Service, Department of Labor, and has begun his service under the Government. Coöperating with the Division of Industrial Hygiene and Medicine and the Division of Labor Administration he will carry on the work of providing for the prevention of accidents in shops and factories.

Mr. Cannon, the new appointee of the department, has been a student at the University of Pennsylvania and the University of Wisconsin. During the war he served as safety superintendent for the International Shipbuilding Corporation at Hog Island. He was connected with the Independence Bureau of Philadelphia for three years. His experience in industrial plants includes service as safety supervisor in the du Pont plant at Carney's Point, as fire chief in the Midvale Steel plant at Eddystone and as chief engineer and electrical engineer in the Workmen's Compensation Bureau, New York.

* * *

Instruction for Shipyard Workers

The Board of Education, Newark, N. J., has perfected arrangements for the inauguration of evening classes of instruction for shipyard workers. The branches of study will include ship construction, machine work, blueprint reading, naval architecture and allied branches. A total of 526 employees from local shipbuilding plants has registered for the course.

* * *

Technical Men Needed in Hospital Workshop

Officers and enlisted men are needed by the Division of Physical Reconstruction for administrative and instruction work in hospitals. Men who have had technical, trade, commercial or agricultural training and experience are especially desired as instructors in the curative workshops.

Authority has been granted by the War Department to transfer to the Reconstruction Division any commissioned or noncommissioned officer or enlisted man from any branch of the service, who is no longer needed in his present assignment and who desires the transfer.

These men will be sent to hospitals functioning in physical reconstruction. The program is now in operation in 25 hospitals with an enrollment of 10,000 disabled soldiers in bedside and ward handicrafts and studies, technical and trade work in shops, agricultural work in hospital farms and gardens, stenography, stenotype, typewriting and other commercial work, and in general academic work.

More than 100 commissioned officers are in charge of the administrative service, and in supervisory positions, and nearly 500 enlisted men are in service as instructors.

The reconstruction work will last until the hospitals are cleared, probably by the summer of 1919.

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The "Howard Evans" Launched

The first launching of the year was the barge "Howard Evans" at the shipbuilding plant of E. J. Tull, Pocomoke City, Md., on Jan. 1.

This new barge is one of the fleet of 20 steam towing boats and barges owned by the Diamond P Boat Line, with office at pier 45, North Philadelphia, Penn. It will be used to carry supplies and equipment to the foundries and shipbuilding plants along the coast, the Delaware River and to New York and Boston.

This barge is 190 ft. long, 23 ft. beam and 12 ft. hold, and has a carrying capacity of 1000 deadweight tons.

* * *

Engineers' Club of Philadelphia Will Hold Interesting Meeting

The Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall on Tuesday, Feb. 18, 1919, 8.15 p.m. Maj. Nevil Monroe Hopkins, Ph.D., of the Technical Research Section of the Ordnance Department, U. S. A., and member of the faculty of George Washington University, Washington, D. C. will present a paper, illustrated with lantern slides, entitled "The Spirit and Outlook for Research and Invention." Members of the club and of affiliated societies are privileged to invite ladies to be present at the meeting.

The following schedule of speakers has been arranged for the Tuesday noon luncheons: Feb: 11, Dr. William D. Lewis, principal of William Penn High School, "What the War Has Taught Us About the Educational Needs of Democracy." Feb. 18, Joseph A. Steinmetz, member, "News from the Peace Zone." Feb. 25, Dr. Edward Chiera, University of Pennsylvania, "The Problem of the Adriatic." Mar. 4, Alfred D. Flinn, secretary of Engineering Council, "Joint Activities of Engineers: A Résumé of the Work of Engineering Council and Engineering Foundation."

Large German Concern Now American Organization

Bosch Magneto Co. Officially Becomes American Bosch Magneto Corporation and Will Extend Its Scope

On Dec. 7, 1918, the Alien Property Custodian of the United States sold the entire property holdings, assets and patent rights of the Bosch Magneto Co. to the highest bidder, the American Bosch Magneto Corporation, which has taken over the entire holdings and organization of the old company, including the great Bosch works at Springfield, Mass., which comprise 250,000 sq. ft. in buildings alone and employ 1500 operatives; also the complete service and selling system throughout the United States, and the entire ownership of all United States and foreign patents and trademarks under which the old company operated.

OFFICERS OF THE NEW COMPANY

The officers of the new company are A. T. Murray, president; George A. MacDonald, vice president and treasurer; A. H. D. Altree, vice president; Leon W. Rosenthal, vice president, and J. A. MacMartin, secretary and assistant treasurer. The directors are A. T. Murray, Martin E. Kern, George A. MacDonald, Henry N. Sweet, C. H. Dwinnell, H. C. Dodge, Duncan C. Holmes, Philip L. Spalding and H. B. Benedict.

Mr. Murray, the president and director of the new company, is also president of the Bethlehem Motors Corporation, Allentown, Penn. Besides managing the Magneto Corporation Mr. Murray will continue as the active head of the Motors Corporation. Mr. MacDonald, vice president and treasurer, is also president of the Chicopee National Bank, Springfield, Mass. Mr. Kern is president of the Penn Counties Trust Co., Allentown, Penn., and is also treasurer of the Bethlehem Motors Corporation. Messrs. Sweet and Benedict are connected with Hornblower & Weeks, bankers, Boston and New York. Mr. Dwinnell is vice president of the First National Bank of Boston, and Mr. Holmes is vice president of the Chase Securities Corporation, New York. Mr. Dodge is chairman of the board of directors of the Gray & Davis Co., Boston, and president of the H. A. Wood Co., also of Boston. Mr. Spalding is president of the New England Telephone and Telegraph Co., Boston, Mass.

It is understood that the new organization intends to engage actively in the production of electrical apparatus for the various branches identified with the American automotive industry.

Surplus Trucks and Automobiles Not to Be Sold at Once

The Director of Munitions contradicts the statement in the newspapers to the effect that the Government intends to put on sale at once all trucks and motor passenger cars that are not being used in the service. The fact is that all trucks owned by the Government will be needed in its service for some time to come. In the disposal of surplus property every care will be taken to see that it is sold in a manner best adapted to cause as little disturbance to trade as possible.

* * *

Large Order for Tractors

The Hart-Parr Co.'s tractor works, Charles City, Iowa, have added $150,000 worth of new rapid, labor-saving machinery to their factory in the past two months. This machinery takes the place of older machinery that was not so economical for their work. The change from war-time to peace production at this factory is being worked out with very little loss to labor or of time. The war orders are nearly all completed and this permits a great increase in production of tractors. Orders for over 4000 are said to have been received for 1919 delivery.

* * *

Employment Service Active

Federal directors of the United States Employment Service from 41 states report that for the week ended Dec. 14 132,798 persons registered for employment. Of these 127,315 were referred out, of which 94,026 were placed in positions.

Of the above total registrations 116,013 were men and 16,785 women. The number of men placed during the week is 30,026; women 14,943, as against 106,490 men and 20,825 women referred.

Applications for help in the week amounted to 240,619 men and 33,018 women, making a total of 273,636.

* * *

Exports Twice as Large as Year's Imports

Heavy December shipments brought the total exports for 1918 to $6,150,000,000, a decrease of only $83,000,000 from the 1917 total, according to an announcement by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

Imports for the year totaled $3,031,000,000, or not quite half the exports. Imports for the previous year were valued at $2,952,000,000.

Exports for December, the first full month after the signing of the armistice, reached $566,000,000, a decided increase over the $522,000,000 recorded for November, although not up to the high mark of $600,000,000 for December, 1917. Imports for December, however, were low, being $211,000,000 against $251,000,000 for the previous November and $288,000,000 for December of the previous year.

Imports as well as exports of gold continued to decrease, the imports amounting to $62,000,000 in the calendar year 1918 against $522,000,000 in 1917, and the exports to $41,000,000 and $372,000,000 in the same year.

Imports of silver increased from $53,000,000 in the calendar year 1917 to $71,000,000 in 1918. The exports of silver during December, 1918, amounted to $48,000,000, a larger amount than in any month during the past three years. For the calendar year exports of silver amounted to $253,000,000 in 1918 against $84,000,000.

Personals

GRAHAM W. BROGAN, formerly with the Duesenberg Motor Corporation, has been made advertising manager of the Black & Decker Manufacturing Co., Baltimore, Md.

CLEMENT BOOTH, until recently engineer in the Standard Roller Bearing factory, Philadelphia, Penn., is now with the Hale & Kilburn Corporation as production engineer.

D. G. CAYWOOD, formerly sales manager of the Brunner Manufacturing Co., Utica, N. Y., has become special representative for the Black & Decker Manufacturing Co., Baltimore, Md.

CHARLES B. WILSON, president and manager of the Wilson Foundry and Machine Co., Pontiac, Mich., has been elected vice president of the Curtiss Airplane and Motor Corporation, Buffalo, N. Y.

JAMES A. BUTLER and F. ALBER HAYES have incorporated under the name of Butler & Haynes, Inc., mechanical and chemical consultants and experimental engineers, with offices at 220 Devonshire St., Boston, Mass.

MAJ. N. C. WALPOLE of the Ordnance Division has received an honorable discharge from the service and has returned to his duties as Southern sales manager of the Niles-Bement-Pond Co. and the Pratt & Whitney Co., with offices at 2015 First Ave., Birmingham, Ala.

A. A. HELLER, treasurer and general manager of the International Oxygen Co., 115 Broadway, New York City, has given up his active duties as manager. EUGENE SCHOEN has been appointed to take his place as manager. Mr. Heller, as treasurer, continues in charge of the financial departments of the business.

C. J. BROWN, connected with the sales division of the R. D. Nuttall Co. for the past three years, has become associated with FRANK M. EBB, representing the Silver Manufacturing Co., the National Forge and Tool Co., the Horseberg Forge Co. and the Meadville Malleable Iron Co. in the Pittsburgh district. Mr. Brown will be located at 902 Second National Bank Building, Pittsburgh.

Business Items

The Hoyt-Noi Steel Co., Chicago, Ill., representative and distributor of Armco products, has changed its name to the General Steel Company.

The New Albany Machine Manufacturing Co. has been incorporated with a capital of $50,000 to manufacture stone machinery. The incorporators are Henry H. Martin, Carl W. Martin and L. E. Martin.

The Onondaga Steel Co., Inc., Syracuse, N. Y., has recently purchased 12 acres of land at Eastwood, near Syracuse. New buildings are planned for the near future, and by early spring it is expected that the entire plant will be removed from Syracuse.

The P-W-V Automatic Machine Corporation, a Massachusetts concern, has purchased the entire radial automatic screw-machine business from the Fitchburg Automatic Machine Works department of the Fitchburg Machine Works, and is making plans for a considerably larger output of this four-spindle screw machine. It is rumored that an extensive modern plant at Springfield is included in the plans. The officers of the new company are C. E. Van Norman, president; L. M. Waite, vice president and sales manager, and C. J. Wetzel, secretary-treasurer.

Obituary

ROLLA C. CARPENTER, who until less than two years ago was professor of experimental engineering at Sibley College, Cornell University, died at his home in Ithaca, N. Y., on Jan. 19. He was a noted inventor and author. His books include the well-known textbooks, "Experimental Engineering," "Heating and Ventilating Buildings" and "Internal Combustion Engines." Besides these he has written many important articles for the American Society of Mechanical Engineers and for various engineering periodicals. He retired from Sibley College early in 1917, after nearly 30 years of teaching. He was a judge in the Department of Machinery at the Chicago Exposition in 1893, the Buffalo Exposition in 1901 and also the Jamestown Exposition in 1907. Professor Carpenter was a member of the following engineering societies and clubs: American Society of Mechanical Engineers, of which he was a past vice president; American Society of Heating and Ventilating Engineers, of which he was a past president; American Institute of Mining Engineers; American Society of Refrigerating Engineers; American Society for Testing Materials; American Society of Automotive Engineers; Michigan Engineering Society, the Engineers' Club and the New York Railroad Club.